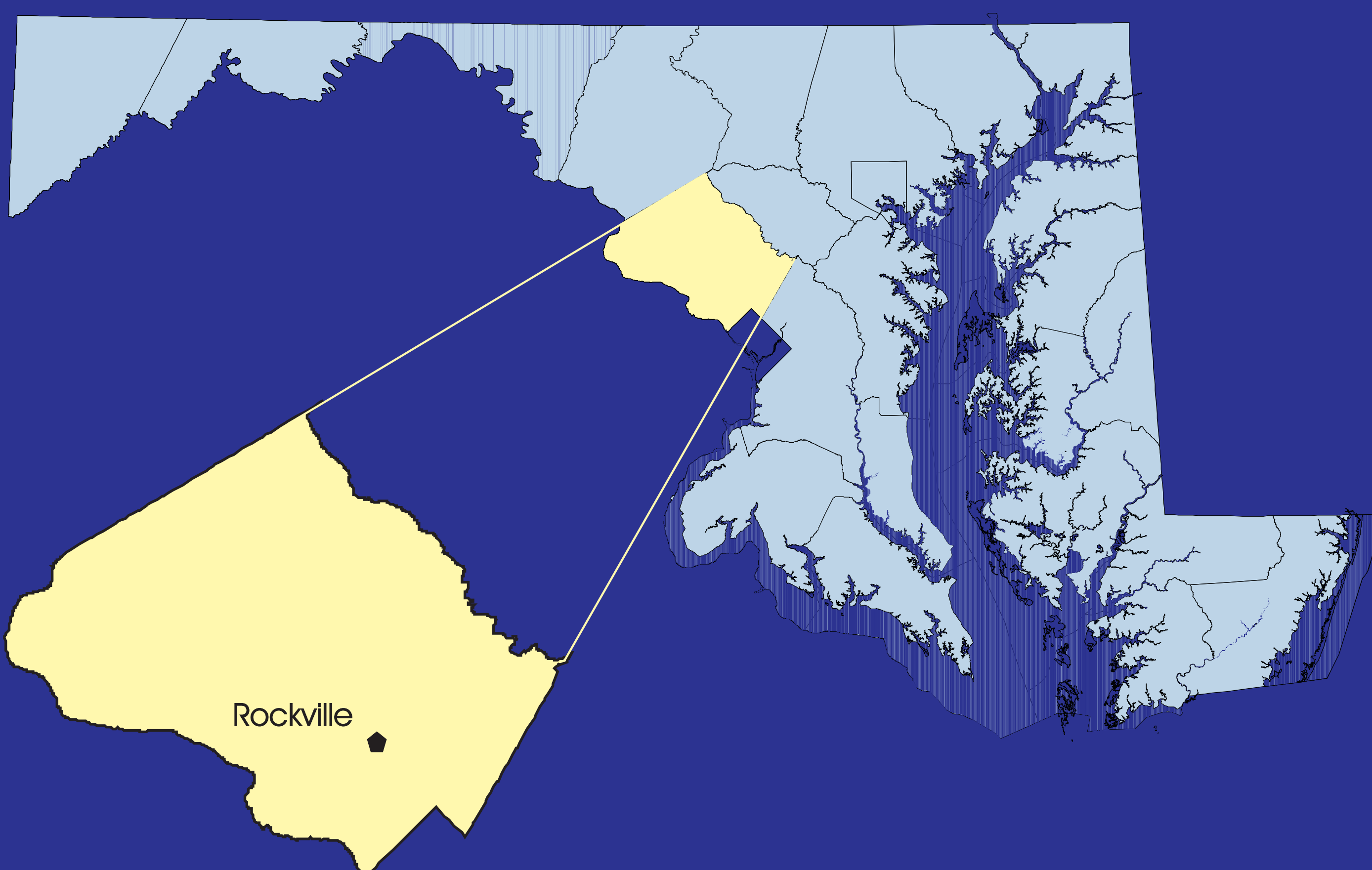
MONTGOMERY COUNTY

RESULTS OF THE 1994-1997 MARYLAND BIOLOGICAL STREAM SURVEY: COUNTY ASSESSMENTS



CHESAPEAKE BAY AND
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Maryland Department of Natural Resources
Tawes State Office Building
580 Taylor Avenue
Annapolis, Maryland 21401

Toll free in Maryland: 1-(877) 620 8DNR x8611
Out of state call: 410-260-8611
www.dnr.state.md.us

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MONTGOMERY COUNTY

Results of the 1994-1997 Maryland Biological Stream Survey: County-Level Assessments

Christopher J. Millard
Paul F. Kazyak
Anthony P. Prochaska

December 2001

Maryland Department of Natural Resources
Resource Assessment Service
Monitoring and Non-Tidal Assessment Division
580 Taylor Avenue
Annapolis, MD 21401

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FOREWORD

This report is based on results of the Maryland Biological Stream Survey (MBSS), a program funded primarily by the Power Plant Research Program and administered by the Maryland Department of Natural Resources (MDNR). Field data for the MBSS were collected by the Maryland Department of Natural Resources. Analyses of water chemistry samples were conducted by the University of Maryland's Appalachian Laboratory. Much of the initial data analysis was conducted by Versar, Inc. for MDNR's Power Plant Assessment Division.

This report helps fulfill two outcomes in MDNR's Strategic Plan: 1) A Vital and Life Sustaining Chesapeake Bay and Its Tributaries, and 2) Sustainable Populations of Living Resources and Healthy Ecosystems.

ACKNOWLEDGMENTS

The 1994-1997 Maryland Biological Stream Survey has been a cooperative effort among several agencies, consultants and academic institutions. We wish to thank Nancy Roth and Ginny Mercurio from Versar in helping to compile some of the data used in this report. Versar also designed the sampling program, obtained landowners' permissions, and helped manage the data. We are also grateful to the many individuals from Maryland Department of Natural Resources, the University of Maryland's Appalachian Laboratory (AL), and the University of Maryland's Wye Research and Education Center (WREC) who comprised the field crews and did a great job collecting the data. MDNR staff also digitized watersheds and calculated land use data, provided quality assurance, and conducted field crew training. Nancy Roth and her colleagues at Versar developed the fish Index of Biotic Integrity, and Dr. Sam Stribling and his staff at Tetra Tech, Inc. developed the benthic Index of Biotic Integrity. Dr. Ray Morgan of AL and Mr. Lenwood Hall of the WREC supervised additional field crews and developed the Physical Habitat Index, and Dr. Keith Eshleman of AL assisted with analyses of data on acidified streams. Drs. Wayne Starnes and Bob Reynolds of the Smithsonian Institution (reptiles and amphibians), Dr. Rich Raesly of Frostburg State University (fish), Rita Villella of the U.S. Geological Survey Leetown Science Center (mussels), and Michael Naylor of MDNR (aquatic vegetation) provided taxonomic verifications of voucher specimens. The success of the project resulted from the strong efforts of all these groups. Special thanks go to Ron Klauda for his editorial support and Brenda Morgan for her assistance in formatting, editing, and organizing the report.

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INTRODUCTION

This report presents county-level data from the 1994-1997 Maryland Biological Stream Survey (MBSS or the Survey). Previous reports have documented interim results from the 1995 (Roth et al. 1997) and 1996 (Roth et al. 1998a) sample years. In addition, a comprehensive final report was produced to assess the "state of the streams" throughout the state (Roth et al. 1999). All previous MBSS reports have presented information by individual drainage basins. Because there is a recognized need for stream health information at the county level, a series of reports were prepared; this report is part of that series. This introductory section recounts the origin of the Survey and describes its components.

Origin of the MBSS

More than 10 years ago, the Maryland Department of Natural Resources (MDNR) recognized that atmospheric deposition was one of the most important environmental problems resulting from the generation of electric power. To determine the extent of acidification of Maryland streams resulting from acidic deposition, MDNR conducted the Maryland Synoptic Stream Chemistry Survey (MSSCS) in 1987. The MSSCS estimated the number and extent of streams at that time affected by or sensitive to acidification statewide and demonstrated the potential for adverse effects on biota from acidification. However, little direct information was available on the biological responses of Maryland streams to water chemistry conditions. Data that were available could not be used (because of methodological differences and spatial coverage limitations) to compare conditions across regions or watersheds (Tornatore et al. 1992). Neither was it possible to assess the interactions between acidic deposition and other anthropogenic and natural influences (CBRM 1989). For these reasons, in 1993, MDNR created the MBSS to provide comprehensive information on the status of biological resources in Maryland streams and how they are affected by acidic deposition and other cumulative effects of anthropogenic stresses.

Description of the MBSS

The MBSS is intended to help environmental decision-makers protect and restore the natural resources of Maryland. The primary objectives of the MBSS are:

- to assess the current status of biological resources in Maryland's non-tidal streams;
- to quantify the extent to which acidic deposition has affected or may be affecting biological resources in the state;
- to examine which other water chemistry, physical habitat, and land use factors are important in explaining the current status of biological resources in streams;
- to compile the first statewide inventory of stream biota;
- to establish a benchmark for long-term monitoring of trends in these biological resources; and
- to target future local-scale assessments and mitigation measures needed to restore degraded biological resources.

In creating the Survey, MDNR implemented a probability-based sampling design as a cost-effective way to characterize statewide stream resources. By randomly selecting sites, the Survey can make quantitative inferences about the characteristics of all 9,258 miles of first-to-third-order, non-tidal streams in Maryland (based on stream length on a 1:250,000-scale base map). MDNR recognized that the utility of these estimates depended on accurately measuring appropriate attributes of streams. The Survey focuses on biology for two reasons: (1) organisms themselves have direct societal value and (2) biological communities integrate stresses over time and are a valuable and cost-effective means of assessing ecological integrity (i.e., the capacity of a resource to sustain its inherent potential).

Fish are an important component of stream integrity and one that also contributes to substantial recreational values. For these reasons, fish communities are a primary focus of the Survey. The Survey collects quantitative data for the calculation of population estimates for individual fish species (both game and nongame). These data can also be used to evaluate fish community composition, individual fish health, and the geographic distribution of commercially important, rare, or non-indigenous fish species. Benthic (bottom-dwelling) macroinvertebrates are another essential component of streams and they constitute the second principal focus of the Survey. The Survey uses rapid bioassessment procedures for collecting benthic macroinvertebrates; these semi-quantitative methods permit comparisons of relative abundance and community composition, and have proven to be an effective way of assessing biological integrity in streams (Hilsenhoff 1987, Lenat 1988, Plafkin et al. 1989, Kerans and Karr 1994, Resh 1995). The Survey also records the presence of reptiles and amphibians (herpetofauna), freshwater mussels, and aquatic plants (both submerged aquatic vegetation (SAV) and emergent macrophytes). The Survey has established rigorous protocols (Kazyak 1996) for each of these sampling components, as well as training and auditing procedures to assure that data quality objectives are met.

Although the MBSS sampling design and protocols provide exceptional information for characterizing the stream resources in Maryland, designation of degraded areas and identification of likely stresses requires additional activities. Assessing the condition of biological resources (whether they are degraded or not degraded) requires the development of ecological indicators that permit the comparison of sampled segment results to minimally impacted reference conditions (i.e., the biological community expected in watersheds with little or no human-induced impacts). The Survey has used its growing database of information collected with consistent methods and broad coverage across the state to develop and test indicators of individual biological components (Stribling et al. 1998, Roth et al. 1998b) and physical habitat quality (Hall et al. 1999). Each of these indicators consists of multiple metrics using the general approach developed for the Index of Biotic Integrity (IBI) (Karr et al. 1986, Karr 1991) and the Chesapeake Bay Benthic Restoration Goals (Ranasinghe et al. 1994). The fish and benthic macroinvertebrate IBIs (which combine attributes of both the number and the type of species found) are widely accepted indicators that have been adapted for use in a variety of geographic locations (Miller et al. 1988, Cairns and Pratt 1993, Simon 1999). The Survey is investigating the possibility of developing additional indicators (e.g., amphibians in small streams with few or no fish) and combining components into a composite indicator of biological integrity.

In addition to developing reference-based indicators, the Survey is applying a variety of analytical methods to the question of which stressors are most closely associated with degraded streams. This involves correlational and multivariate analyses of water chemistry, physical habitat, land use, and biological information (e.g., presence of non-native species). The biological information also provides a valuable opportunity for documenting aquatic biodiversity across the state; the distribution and abundance of species previously designated as rare only by anecdotal evidence can be determined, and unique combinations of species at the ecosystem and landscape levels can be identified. Land use and other landscape-scale metrics will play an important role in identifying the relative contributions of different stressors to the cumulative impact on stream resources. Ultimately, the Survey seeks to provide an integrated assessment of the problems facing Maryland streams that will facilitate interdisciplinary solutions for their restoration. The survey also provides resource managers with the locations of relatively undisturbed streams and watersheds that deserve protection.

METHODS

This section presents the specific study design and procedures used to implement the Maryland Biological Stream Survey. The study area of concern and the sampling design developed to characterize it are presented, along with field and laboratory methods for each component: fish, benthic macroinvertebrates, reptiles and amphibians, physical habitat, and water chemistry. Methods for aquatic vegetation and mussel sampling are presented, but the resulting data are not included in this report. A full description of MBSS methods can be found in Kazyak (1996).

MBSS Study Design

The Survey study area comprises 17 distinct drainage basins across the state. Random sampling was used to allow the estimation of unbiased summary statistics (e.g., means, proportions, and their respective variances) for the entire state, a particular basin, and subpopulations of interest (e.g., streams with pH < 5).

Because it would have been cost prohibitive to visit a sufficient number of sites in all basins in a single year, lattice sampling was used to schedule sampling of all basins over a three-year period, 1995-1997. Lattice sampling, also known as multistratification, is a cost-effective means of allocating effort across time in a large geographic area (Heimbuch 1999, Jessen 1978, Cochran 1977). A table, or lattice, was formed by arranging 17 basins in 17 rows, and the years in 3 columns. Lattice sampling was the method used for selecting cells from this 17x3 table so that all basins would be sampled over a three-year period and all basins would have a non-zero probability of being sampled in a given year. The data presented in this report include those collected at random sampling sites within the 17 principal basins in Maryland, as well as sites from the 1994 demonstration project. Because no estimates were calculated for this report, these data were included to supplement the number of sites.

The sampling frame for the Survey was constructed by overlaying basin boundaries on a map of all blue-line stream reaches in the study area as digitized on a U.S. Geological Survey 1:250,000 scale topographic map. This sample frame was similar to that used by the earlier Maryland Synoptic Stream Chemistry Survey (MSSCS) conducted in 1987 (Knapp and Saunders 1987, Knapp et al. 1988). The Strahler convention (Strahler 1957) was used for ranking stream reaches by order; first-order reaches, for example, are the most upstream reaches in the branching stream system. Sampling was restricted to non-tidal, third-order and smaller stream reaches, excluding impoundments that were non-wadable or that substantially altered the riverine nature of the reach (Kazyak 1994). Together, these first-through third-order streams comprise about 90% of all stream and river miles in Maryland. Stream reaches were further divided into non-overlapping, 75-meter segments; these segments were the elementary sampling units from which biological, water chemistry, and physical habitat data were collected.

The 1995-1997 MBSS study design was based on stratified random sampling of segments within each basin; each basin was stratified by stream order. Within a stream order, the number of segments sampled per basin is proportional to the number of stream miles in the basin. To achieve the target number of samples per stream order within each basin, a given number of segments were randomly selected from each basin and ranked in order of selection. In all basins, extra segments were selected as a contingency against loss of sampling sites from restricted access to selected streams or from streams that were dry, too deep, or otherwise unsampleable owing to field conditions. In some basins, where only a small number of sites would have been selected using this method, additional random sites were selected to increase sample size. These extra sites (selected at random using the method described above) were used to provide better basinwide estimates; they were not included in the estimates of statewide conditions.

Permissions were obtained to access privately owned land adjacent to or near each stream segment. The procedures for obtaining permissions are described in Chaillou (1995). Because landowner permissions were obtained in a synoptic fashion and some variation in these rates occurred, we obtained more permissions than were needed for the Survey. Only the highest ranking sites were sampled until the target goal for that basin was reached. For the three year study, the success rate for obtaining permission to access stream sampling segments was high. Eighty-eight percent of sites that were targeted for permission were sampled.

Reasons for permission denial varied and generally reflected the preferences of landowners regarding property access, rather than any specific types of land. In rare cases, permission denial may affect the interpretation of Survey estimates, but only where denials occur in streams with characteristics that differ from the general population of streams. In one example of potential bias, several sites with known coal mining activities in the North Branch Potomac basin denied permission to sample, likely under representing the proportion of acid mine drainage streams in the population.

Field and Laboratory Methods

Benthic macroinvertebrate and water quality sampling were conducted in spring, when the benthos are thought to be reliable indicators of environmental stress (Plafkin et al. 1989) and when acid deposition effects are often the most pronounced. Fish, reptiles and amphibians, aquatic vegetation, and mussel sampling, along with physical habitat evaluations, were conducted during the low-flow period in summer. Fish community composition tends to be stable during summer, and low flow is advantageous for electrofishing. Because low-flow conditions in summer may be a primary factor limiting the abundance and distribution of fish populations, habitat assessments were performed during the summer. The sample size in summer is lower than in spring because some streams were dry in summer or were, in rare cases, otherwise unsampleable.

To reduce temporal variability, sampling during spring and summer was conducted within specific, relatively narrow time intervals, referred to as index periods (Janicki et al. 1993). These index periods were defined by degree-day limits for specific parts of the state. This approach provided a synoptic assessment of the current status of stream biota, water quality, and physical habitat in the 17 basins sampled. The spring index period was the time period between approximately March 1 and May 1, with end of the index period determined by degree-day accumulation as specified in Hilsenhoff (1987). In reality, most spring samples (78%) were collected in March, well before degree-day accumulation limits were approached. The summer index period was between June 1 and September 30 (Kazyak 1994).

Data Collection and Measurement

Field sampling followed procedures specified in the MBSS sampling manual (e.g., Kazyak 1996). A summary of the variables measured and the field and laboratory methods used to conduct the sampling follows.

Fish

Fish were sampled during the summer index period using double-pass electrofishing within 75-meter stream segments. Block nets were placed at each end of the segment and direct current backpack electrofishing units were used to sample the entire segment. An attempt was made to thoroughly fish each segment, and consistent effort was applied over the two passes. This sampling approach allowed calculation of several metrics useful in calculating a biological index and produced unbiased estimates of fish species abundance.

In small streams, a single electrofishing unit was used. In larger streams, two to five units were employed to effectively sample the site. Captured fish were identified to species, counted, weighed, and released. Any individuals that could not be identified to species were retained for laboratory confirmation. For each pass, all individuals of each gamefish species (defined as trout, bass, walleye, pike, chain pickerel, and striped bass) were measured for total length and examined for visible external pathologies or anomalies. For nongame species, up to 100 fish of each species (from both passes) were examined for visible external pathologies or anomalies. For each pass, all non-game species were weighed together for an aggregate biomass measurement; gamefish were also weighed in aggregate to the nearest 10 g.

Electrofishing was also conducted at supplemental, non-randomly selected sites during the summer index period. The presence of each species of fish was recorded for these segments to provide additional qualitative information on statewide fish distributions. Sampling effort at most qualitative sites was based on doubling the elapsed time since the last species was recorded or a minimum of 600 seconds of electrofishing effort.

After processing the fish collected in the field, voucher specimens were retained for each species not previously collected in the drainage basin. In addition, all individuals which could not be positively identified in the field were retained. The remaining fish were released. All voucher specimens and fish retained for positive identification in the laboratory were examined and verified by the MBSS Quality Assurance Officer or ichthyologists at Frostburg State University, Frostburg, Maryland or the Smithsonian Institution, Washington, DC.

Benthic Macroinvertebrates

Benthic macroinvertebrates were collected to provide a qualitative description of the community composition at each sampling site (Kazyak 1996). Sampling was conducted during the spring index period. Benthic community data were collected for the purpose of calculating biological metrics, such as those described in EPA's Rapid Bioassessment Protocols (Plafkin et al. 1989), and use as an indicator of biological integrity for Maryland streams.

At each segment, a 600 micron mesh "D" net was used to collect organisms from habitats likely to support the greatest taxonomic diversity. A riffle area was preferred, but other habitats were also sampled using a variety of techniques including kicking, jabbing, and gently rubbing hard surfaces by hand to dislodge organisms. If available, other habitat types were sampled, including rootwads, woody debris, leaf packs, macrophytes, and undercut banks. Each jab covered one square foot, and a total of approximately 2.0 m^2 (20 square feet) of combined substrates was sampled and preserved in 70% ethanol. In the laboratory, the preserved sample was transferred to a gridded pan and organisms were picked from randomly selected grid cells until the cell that contained the 100th individual (if possible) was completely picked. Some samples had fewer than 100 individuals. The benthic macroinvertebrates were identified to genus, or lowest practicable taxon, in the laboratory.

Index of Biotic Integrity

Sites were evaluated using both the fish (F-IBI) and benthic macroinvertebrate (B-IBI) IBIs developed for the MBSS (for detailed methods, see Roth et al. 1997 and Stribling et al. 1998). IBI scores for the MBSS are determined by comparing the fish or benthic macroinvertebrate assemblages at each site to those found at minimally impacted reference sites. Three separate formulations were employed for the fish IBI, one for each of three distinct geographic areas: Coastal Plain, Eastern Piedmont, and Highland. The two formulations used for the benthic IBI cover the Coastal Plain and non-Coastal Plain regions. Individual metrics for the IBI are scored 1, 3, or 5, based on comparison with the distribution of metric values at reference sites. For either the individual metrics or total IBI, a score of 3 or greater is considered comparable to reference site conditions, while scores falling below this threshold differ significantly from the reference conditions. Scores for the MBSS IBIs are calculated as the mean of the individual metric scores and therefore range from 1 to 5. Some other programs have used a similar approach (e.g., Weisberg et al. 1997), while others have instead computed the IBI as the total of individual metric scores. For example, Karr et al. (1986) calculated IBI as the sum of 12 metric scores, with totals ranging from 12 to 60 points.

Reptiles and Amphibians

At each sample segment, reptiles and amphibians were identified and the presence of observed species was recorded during the summer index period. A search of the riparian area was conducted within 5 meters of the stream on both sides of the 75-meter segment. Any reptiles and amphibians collected during the electrofishing of the stream segment were also included in the species list. Individuals were identified to species when possible. Voucher specimens and individuals not positively identifiable in the field were retained for examination in the laboratory and confirmation by herpetologists at the Smithsonian Institution, Washington, DC, or Towson University, Towson, Maryland.

Physical Habitat

Habitat assessments were conducted at all stream segments as a means of assessing the importance of physical habitat to the biological integrity and fishability of freshwater streams in Maryland. Procedures for habitat assessments (Kazyak 1996) were derived from two currently used methodologies: EPA's Rapid

Bioassessment Protocols (RBPs) (Plafkin et al. 1989), as modified by Barbour and Stribling (1991), and the Ohio EPA's Qualitative Habitat Evaluation Index (QHEI) (Ohio EPA 1987, Rankin 1989). A number of characteristics (instream habitat, epifaunal substrate, velocity/depth diversity, pool/glide/eddy quality, riffle/run quality, channel alteration, bank stability, embeddedness, channel flow status, and shading) were assessed qualitatively, based on visual observations within each 75-meter sample segment. Riparian zone vegetation width was estimated to the nearest meter, up to 50 meters from the stream. Additional observations of the surrounding area were used to assign ratings for aesthetic value (based on visible signs of human refuse at a site) and remoteness (based on distance from the nearest road, accessibility, and evidence of human activity). Also recorded were the presence or absence of various stream features including substrate types, various morphological characteristics, beaver ponds, point sources, and stream channelization. Local land uses visible from the stream segment and riparian vegetation type were also noted. Several additional physical characteristics were measured quantitatively to further characterize the habitat for each segment (see Kazyak 1996 for details). Quantitative measurements of the segment included maximum depth, stream gradient, velocity, thalweg depth, number of functional rootwads, number of functional large woody debris, wetted width, sinuosity, and overbank flood height. A velocity/depth profile was measured or other data were collected to enable calculation of discharge.

Physical Habitat Index

The Physical Habitat Index (PHI) was developed using MBSS data from 1994 to 1997 (Hall et al. 1999). As was the case in development of the fish and benthic IBIs, the conceptual approach was based on evaluating the relative importance (discriminatory power) of individual metrics and combinations of metrics explaining natural differences in streams throughout Maryland. These metrics were derived from both quantitative and qualitative habitat data collected during the summer index period. Based on analyses conducted for both fish IBI (Roth et al. 1998) and benthic macroinvertebrate IBI (Stribling et al. 1998) development in Maryland, the State was divided into two regions: the Coastal Plain and non-Coastal Plain. The resulting index was then adjusted to a centile scale that rated each sample segment as follows: Good - 72 to 100; Fair - 42 to 71.9; Poor - 12 to 41.9; and Very Poor - 0 to 11.9.

Water Chemistry

During the spring index period, water samples were collected at each site for analysis of pH, acid neutralizing capacity (ANC), conductivity, sulfate, nitrate-nitrogen, and dissolved organic carbon (DOC). These variables describe basic water quality conditions with an emphasis on factors related to acidic deposition.

Grab samples were collected in one-liter bottles for analysis of all analytes except pH. Water samples for pH were collected with 60 ml syringes, which allowed purging of air bubbles to minimize changes in carbon dioxide content (EPA 1987). Samples were stored on wet ice and shipped on wet ice to the analytical laboratory within 48 hours. Laboratory analyses were carried out by the University of Maryland's Appalachian Laboratory in Frostburg.

Chemical analysis of water samples followed standard methods described in EPA's Handbook of Methods for Acid Deposition Studies (EPA 1987). EPA protocols were followed, except that ANC sample volume was reduced to 40 ml to ease handling. Routine daily quality control (QC) checks included processing duplicate, blank, and calibration samples according to EPA guidelines for each analyte. Field duplicates were taken at 5% of all sites. Routine QC checks helped to identify and correct errors in sampling routines or instrumentation at the earliest possible stage.

During the summer index period, in situ measurements of dissolved oxygen (DO), pH, temperature, and conductivity were collected at each site to further characterize existing water quality conditions that might influence biological communities. Measurements were made at an undisturbed section of the segment, usually in the middle of the stream channel, using electrode probes. Instruments were calibrated daily and calibration logbooks were maintained to document instrument performance.

Recognizing that water temperature is an important factor affecting stream condition, but one that varies daily and seasonally, temperature loggers were deployed at 220 sites in five basins during 1997. The basins sampled were: the Choptank, Susquehanna, Potomac Washington Metro, Patuxent, and Pocomoke. Onset Computer Corporation Optic Stowaway temperature loggers were anchored in each site during the summer index period. Water temperature was recorded every 15 minutes from June 15 until mid-September.

Mussels

During the summer index period, freshwater mussels were sampled qualitatively by examining each 75-meter stream segment for their presence. Mussels were identified to species, their presence recorded, and subsequently released. Species not positively identifiable in the field were retained for confirmation by U.S. Geological Survey (USGS) Biological Resources Division staff.

Aquatic Vegetation

Aquatic vegetation was sampled qualitatively by examining each 75-meter segment for the presence of aquatic plants. Plants were identified to species and their presence recorded for each site. While the primary objective was to document the presence of submerged aquatic vegetation (SAV), emergent and floating aquatic vegetation was also recorded when encountered. Species not positively identifiable in the field were retained for laboratory examination and confirmation by MDNR's staff expert on SAV. Due to the difficulty in long-term preservation, no permanent vouchers of aquatic vegetation were retained.

Data Management

All crews used standardized pre-printed data forms developed for the Survey to ensure that all data for each sampling segment were recorded and standard units of measure were used (Kazyak 1996). Using standard data forms facilitated data entry and minimized transcription error. The field crew leader and a second reviewer checked all data sheets for completeness and legibility before leaving each sampling location. Original data sheets were sent to the Data Management Officer for further review and data entry, while copies were retained by the field crews.

A custom database application, in which the input module was designed to match each of the field data sheets, was used for data entry. Data were independently entered into two databases and compared using a computer program as a quality-control procedure. Differences between the two databases were resolved from original data sheets or through discussions with field crew leaders.

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Maryland Biological Stream Survey Data

COUNTY SUMMARY

A total of 130 quantitative sites were sampled in Montgomery County by MBSS sampling crews during 1994-1997 (Table 1; Figure 2). Qualitative fish sampling was conducted at an additional 16 sites to provide a more complete picture of fish species distributions. Appendix A provides a summary of the types of data available for each of the sites sampled.

Species Highlights

Forty-eight fish species were collected in the small to mid-sized streams that were sampled; this number ranks second in the state. Eight percent of the sites contained no fish (Table 2). The likely reasons for the relatively high number of fishless sites include migration barriers from road culverts, reduced baseflow and greatly increased stormflow from the large number of impervious surfaces, and channel modifications that reduce or effectively eliminate fish habitat (e.g., concrete trapezoids).

Blacknose dace and creek chub, two pollution-tolerant species, were the most commonly encountered species (Table 2). Brook trout, a temperature-sensitive species formerly widespread in the county, was not collected and has almost certainly been extirpated. Historical agricultural land use and increasing urbanization (and subsequent increase in runoff from impervious surfaces) are likely reasons for the disappearance of brook trout. No rare fish species were collected.

The 180 genera of benthic macroinvertebrates found in Montgomery County ranks sixth best among Maryland counties for benthic diversity (Table 3). A likely contributing reason for the relatively high fish and benthic diversity is the proximity of many county streams to the mainstem Potomac River and its diverse array of species. In many cases, the Potomac also provides a source of re-colonization after episodes of adverse conditions that are common in urban stream systems.

Twenty-four species of reptiles and amphibians were found in or near Montgomery county streams (Table 4), tying the county for a ranking of second best in the state. No state or federally listed species were collected. However, queen snake, a species under consideration for state listing, was collected at a single site.

Ecological Health

The overall ecological health of Montgomery County's headwater streams can best be described as Fair to Poor. The average F-IBI score among sites was 3.18 (low end of the Fair range, ranking fifteenth among counties in the state) and the average B-IBI score among sites was 2.3 (low end of the Poor category, ranking nineteenth among counties in the state). Based on the MBSS F-IBI and B-IBI scores from individual sites, the highest rated streams in the county are the mainstem Patuxent River and Little Seneca Creek (Table 6). The worst rated streams include: Goshen Branch, Bogley Branch, Sligo Creek, an unnamed tributary to Mill Creek, Little Falls, Great Seneca Creek, and an unnamed tributary to Cabin John Creek.

Physical Habitat

Physical habitat in Montgomery County was rated as Fair by the Physical Habitat Index. Values ranged from 3.2 to 93.5, with an average score of 51.1 (low end of the Fair range, ranking fourteenth among counties in the state) (Table 6; Figure 5). Other noteworthy points about Montgomery County streams include a ranking of twenty-first for large woody debris abundance and a ranking of eighteenth for instream rootwads (trees whose roots protect banks from erosion and provide habitat for aquatic life). However, instream habitat and epifaunal substrate, with an average rating of 12 and 10, respectively, ranked among the best scores in the state.

Nitrate-Nitrogen

Nitrate-nitrogen values at sites sampled in Montgomery County averaged 2.38 mg/L, or eleventh best among counties in the state. The streams with the lowest nitrate values in the county at the time of sampling were Cabin John Creek and Gunner's Branch. The streams with the highest nitrate values were an unnamed tributary to Watt's Branch, an unnamed tributary to Seneca Creek, and Whetstone Branch (Table 7). The EPA limit for nitrate-nitrogen in drinking water (10 mg/L) was not exceeded at any site.

Table 1. Site information and land use data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Basin abbreviations are as follows: MP - Middle Potomac River; PX - Patuxent River; PW - Potomac Washington Metro.

Site	Latitude	Longitude	Stream Name	Basin	Order	Catchment Acres	% Urban	% Agric.	% Forest
HO-P-132-312-97	39.2510	77.0670	Mainstem Patuxent R	PX	3	19846.43	0.65	62.84	33.20
HO-P-132-319-97	39.2550	77.0740	Mainstem Patuxent R	PX	3	19582.73	0.66	62.97	33.19
HO-P-194-310-97	39.2970	77.1480	Mainstem Patuxent R	PX	3	6824.00	1.56	58.21	37.90
HO-P-214-311-97	39.3040	77.1600	Mainstem Patuxent R	PX	3	4989.89	2.07	52.56	42.82
MO-P-001-214-97	39.0900	77.1720	Watts Br	PW	2	1495.54	37.39	34.31	26.41
MO-P-006-1-94	39.2049	77.1890	Goshen Br	PW	2	2562.10	0.22	76.91	19.63
MO-P-006-2-94	39.2105	77.1816	Goshen Br	PW	2	2320.90	0.24	75.87	20.69
MO-P-014-107-97	39.1550	77.5170	Un Trib To Potomac R	PW	1	379.47	0.00	74.22	25.78
MO-P-016-227-97	39.1540	77.4350	Broad Run	PW	2	1396.23	1.34	75.14	18.36
MO-P-022-3-94	39.1121	77.3391	Seneca Cr	PW	1	523.20	0.12	77.94	16.59
MO-P-022-5-94	39.1264	77.3514	Seneca Cr	PW	1	26.60	0.00	59.02	12.78
MO-P-022-6-94	39.1114	77.3390	Seneca Cr	PW	1	618.70	0.10	77.62	17.54
MO-P-024-307-97	39.2050	77.2740	Little Seneca Cr	PW	3	4475.16	2.87	75.71	18.16
MO-P-024-315-97	39.2050	77.2720	Little Seneca Cr	PW	3	4462.26	2.85	75.91	17.99
MO-P-025-1-94	39.1390	77.2037	Long Draught Br	PW	1	133.00	88.57	8.65	2.78
MO-P-025-2-94	39.1432	77.2215	Long Draught Br	PW	1	438.30	60.10	29.48	9.03
MO-P-035-227-97	39.1890	77.0400	Hawlings R	PX	2	10351.48	0.47	65.29	30.03
MO-P-038-1-94	39.0422	77.2293	Watts Br	PW	3	9395.90	29.11	32.12	36.79
MO-P-038-2-94	39.0446	77.2278	Watts Br	PW	3	9380.80	29.16	32.14	36.71
MO-P-038-3-94	39.0407	77.2319	Watts Br	PW	3	9420.70	29.02	32.19	36.80
MO-P-053-2-94	39.2044	77.1887	Goshen Br	PW	2	1721.10	1.90	55.23	41.07
MO-P-053-7-94	39.2042	77.1879	Goshen Br	PW	2	1720.40	1.90	55.27	41.17
MO-P-056-319-97	39.0620	77.0230	Northwest Br Anacostia R	PW	3	14466.82	22.39	38.07	37.93
MO-P-059-320-97	39.2650	77.0990	Mainstem Patuxent R	PX	3	17004.48	0.76	64.03	32.07
MO-P-064-328-97	39.2150	77.4380	Little Monocacy R	PW	3	10826.54	0.41	60.56	36.03
MO-P-069-1-94	39.1485	77.1828	Whetstone Run	PW	1	313.60	54.84	15.89	27.77
MO-P-069-5-94	39.1536	77.1883	Whetstone Run	PW	1	489.20	54.93	22.40	21.35
MO-P-082-124-97	39.0550	77.1350	Un Trib To Cabin John Cr	PW	1	484.30	49.93	29.73	20.13
MO-P-086-1-94	39.0365	77.1540	Cabin John Cr	PW	3	5067.20	48.53	13.62	36.76
MO-P-086-2-94	39.0338	77.1560	Cabin John Cr	PW	3	5152.90	48.03	13.64	37.08
MO-P-091-204-97	39.1080	77.2330	Muddy Br	PW	2	4266.05	38.79	42.62	16.86
MO-P-099-1-94	39.1546	77.2248	Great Seneca Cr	PW	1	437.60	56.52	30.82	11.48
MO-P-099-2-94	39.1551	77.2253	Great Seneca Cr	PW	1	442.60	55.78	31.25	11.57
MO-P-101-126-97	39.0710	77.0800	Un Trib To Rock Cr	PW	1	498.28	80.53	2.93	16.47
MO-P-102-308-97	39.0940	77.3470	Dry Seneca Cr	PW	3	4311.14	1.87	67.11	27.41
MO-P-103-1-94	39.0399	77.2234	Watts Br #2	PW	1	239.50	4.97	52.99	42.05
MO-P-103-2-94	39.0400	77.2243	Watts Br #2	PW	1	312.50	7.40	47.18	44.88
MO-P-108-123-97	39.0940	77.1830	Un Trib To Watts Br	PW	1	509.87	51.81	44.03	3.76
MO-P-110-223-97	39.1090	77.0260	Northwest Br	PW	2	3590.69	3.18	52.61	43.26
MO-P-111-136-96	39.2571	77.2831	Un Trib To Little Bennet Cr	MP	1	260.63	0.00	38.48	61.52
MO-P-118-1-94	39.2060	77.1946	Goshen Br	PW	3	4566.40	0.87	68.10	28.13
MO-P-118-2-94	39.2062	77.1931	Goshen Br	PW	3	4547.70	0.87	68.05	28.24
MO-P-126-206-97	39.2330	77.1130	Hawlings R	PX	2	1171.82	0.00	75.02	18.32
MO-P-128-118-97	39.2040	77.3610	Bucklodge Br	PW	1	155.30	0.00	82.40	17.60
MO-P-129-114-97	39.1590	77.2990	Un Trib To Seneca Cr	PW	1	80.46	0.00	88.56	11.44
MO-P-129-119-97	39.1630	77.3170	Un Trib To Seneca Cr	PW	1	576.28	0.00	74.82	23.76
MO-P-129-131-97	39.1570	77.3080	Un Trib To Seneca Cr	PW	1	268.38	0.00	89.47	9.26
MO-P-153-113-97	39.1610	77.1320	Un Trib To Rock Cr	PW	1	574.52	1.18	59.05	23.43

Table 1 (cont.). Site information and land use data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Basin abbreviations are as follows: MP - Middle Potomac River; PX - Patuxent River; PW - Potomac Washington Metro.

Site	Latitude	Longitude	Stream Name	Basin	Order	Catchment Acres	% Urban	% Agric.	% Forest
MO-P-159-110-97	39.1840	77.2410	Gunners Br	PW	1	219.51	27.51	52.24	20.09
MO-P-180-1-94	39.0450	77.2274	Watts Br	PW	2	6933.60	37.81	27.04	33.94
MO-P-180-2-94	39.0456	77.2252	Watts Br	PW	2	6919.20	37.89	27.09	33.81
MO-P-180-3-94	39.0461	77.2237	Watts Br	PW	2	6913.20	37.93	27.12	33.75
MO-P-182-325-97	39.0100	77.1680	Cabin John Cr	PW	3	8611.67	47.29	12.95	38.90
MO-P-190-302-97	39.1050	77.3650	Dry Seneca Cr	PW	3	3059.18	2.63	67.51	26.06
MO-P-192-1-94	39.0620	77.1670	Bogley Br	PW	1	80.90	62.67	4.57	32.76
MO-P-192-2-94	39.0626	77.1673	Bogley Br	PW	1	80.20	62.72	4.61	32.67
MO-P-204-137-97	39.1190	76.9120	Un Trib To Rocky Gorge Res	PX	1	613.12	6.51	47.61	45.83
MO-P-206-311-97	39.1290	77.4670	Broad Run	PW	3	6818.83	0.49	70.80	22.78
MO-P-213-205-97	39.2100	77.0720	Hawlings R	PX	2	6112.26	0.70	67.47	26.50
MO-P-233-1-94	39.0435	77.2522	Watts Br	PW	3	10589.70	26.18	33.71	38.11
MO-P-233-2-94	39.0424	77.2500	Watts Br	PW	3	10536.00	26.27	33.79	37.95
MO-P-245-303-97	39.1760	77.0120	Hawlings R	PX	3	17795.67	5.65	59.50	31.22
MO-P-248-125-96	39.3016	77.2158	Bennet Cr	MP	1	584.54	3.96	39.41	54.89
MO-P-251-115-97	39.2210	77.3660	Un Trib To Little Monocacy R	PW	1	497.11	0.14	83.97	13.34
MO-P-252-323-97	39.2850	77.1410	Mainstem Patuxent R	PX	3	8636.08	1.44	61.66	34.70
MO-P-258-213-97	39.0930	76.9260	Little Paint Br	PW	2	739.08	26.45	31.69	37.72
MO-P-265-4-94	39.0636	77.2650	Stony Cr	PW	1	108.40	0.00	88.75	10.98
MO-P-265-5-94	39.0661	77.2661	Stony Cr	PW	1	66.70	0.00	93.40	6.15
MO-P-269-203-97	39.0040	77.0140	Sligo Cr	PW	2	3398.22	65.61	4.72	29.52
MO-P-276-211-97	39.2200	77.2180	Wild Cat Br	PW	2	1688.72	0.79	81.49	16.05
MO-P-286-1-94	39.1591	77.1961	Whetstone Run	PW	2	1584.80	51.94	31.35	11.40
MO-P-286-2-94	39.1611	77.1985	Whetstone Run	PW	2	1808.40	52.80	29.74	12.07
MO-P-296-1-94	39.0776	77.1814	Watts Br	PW	2	2817.90	43.84	34.51	20.07
MO-P-296-2-94	39.0840	77.1788	Watts Br	PW	2	2388.00	42.64	35.68	20.04
MO-P-304-127-97	39.0960	77.0130	Un Trib To Northwest Br	PW	1	248.84	64.21	9.15	26.64
MO-P-308-117-97	39.1340	77.1610	Un Trib To Mill Cr	PW	1	377.13	48.91	26.90	20.29
MO-P-310-313-97	39.1050	77.1260	Rock Cr	PW	3	10606.55	21.94	51.42	22.17
MO-P-311-112-97	39.1840	77.3890	Dry Seneca Cr	PW	1	759.03	0.09	87.26	9.12
MO-P-316-205-97	39.1340	77.1530	Mill Cr	PW	2	1096.69	49.36	25.19	20.43
MO-P-325-208-97	39.1550	77.1050	North Br Rock Cr	PW	2	1755.09	1.71	53.79	39.52
MO-P-325-216-97	39.1490	77.1030	North Br Rock Cr	PW	2	2050.31	1.44	56.49	37.42
MO-P-333-207-97	39.2250	77.1970	Great Seneca Cr	PW	2	8417.07	5.27	64.63	26.75
MO-P-333-224-97	39.2220	77.2020	Great Seneca Cr	PW	2	8623.74	5.14	64.79	26.78
MO-P-361-8-94	39.1417	77.2615	Long Draught Br	PW	2	1931.50	52.94	23.50	22.46
MO-P-366-212-97	39.2270	77.3110	Ten Mile Cr	PW	2	1782.36	2.95	40.65	56.30
MO-P-370-308-97	39.2630	77.0930	Mainstem Patuxent R	PX	3	18539.28	0.70	63.51	32.77
MO-P-407-225-97	39.1160	77.0350	Un Trib To Northwest Br	PW	2	2198.27	8.27	49.83	41.76
MO-P-419-1-94	39.2156	77.1473	Goshen Br	PW	1	101.40	2.00	89.50	8.50
MO-P-419-2-94	39.2149	77.1567	Goshen Br	PW	1	250.90	2.28	90.78	6.93
MO-P-428-106-97	39.2080	77.2760	Un Trib To Little Seneca Cr	PW	1	439.96	13.58	55.63	28.94
MO-P-432-1-94	38.9576	77.1092	Little Falls	PW	1	2326.00	66.45	9.04	24.43
MO-P-432-2-94	38.9510	77.1135	Little Falls	PW	1	2803.50	65.63	7.75	26.21
MO-P-436-226-97	39.0830	77.3950	Un Trib To Potomac R	PW	2	1126.73	0.06	51.59	46.87
MO-P-437-206-97	39.1380	77.1290	Rock Cr	PW	2	4748.66	2.07	71.50	20.08
MO-P-437-210-97	39.1450	77.1250	Rock Cr	PW	2	4375.97	2.07	72.55	18.77
MO-P-445-318-97	39.2120	77.2060	Great Seneca Cr	PW	3	11330.77	4.03	66.47	26.66

Table 1 (cont.). Site information and land use data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Basin abbreviations are as follows: MP - Middle Potomac River; PX - Patuxent River; PW - Potomac Washington Metro.

Site	Latitude	Longitude	Stream Name	Basin	Order	Catchment Acres	% Urban	% Agric.	% Forest
MO-P-452-1-94	39.1341	77.2248	Long Draught Br	PW	1	48.30	64.80	26.09	9.11
MO-P-452-2-94	39.1338	77.2283	Long Draught Br	PW	1	113.20	72.17	18.55	9.28
MO-P-454-3-94	39.1558	77.1819	Whetstone Run	PW	1	470.20	45.55	37.79	3.54
MO-P-454-4-94	39.1542	77.1762	Whetstone Run	PW	1	406.60	48.57	34.64	2.93
MO-P-468-109-97	39.2810	77.2060	Magruder Br	PW	1	160.19	23.03	69.30	7.68
MO-P-470-1-94	39.1666	77.2198	Whetstone Run	PW	2	2936.40	57.24	26.09	12.27
MO-P-470-2-94	39.1673	77.2256	Whetstone Run	PW	2	3036.50	56.98	26.02	12.21
MO-P-474-317-97	39.1460	77.3360	Seneca Cr	PW	3	18421.62	4.51	54.30	38.71
MO-P-478-312-97	38.9730	77.1510	Cabin John Cr	PW	3	15988.57	44.30	13.10	42.04
MO-P-480-2-94	38.9897	77.1605	Cabin John Cr	PW	3	12739.90	43.45	15.17	40.69
MO-P-480-326-97	38.9840	77.1600	Cabin John Cr	PW	3	12988.76	43.82	14.91	40.60
MO-P-480-3-94	38.9877	77.1609	Cabin John Cr	PW	3	12786.80	43.48	15.13	40.70
MO-P-481-101-97	39.1980	77.4600	Un Trib To Potomac R	PW	1	183.03	0.19	79.12	20.69
MO-P-488-1-94	39.0489	77.1545	Cabin John Cr	PW	2	2275.80	50.57	15.13	33.21
MO-P-488-2-94	39.0508	77.1553	Cabin John Cr	PW	2	2254.90	50.65	15.32	32.93
MO-P-489-314-97	39.0930	77.0320	Northwest Br	PW	3	8231.35	7.83	51.49	39.51
MO-P-489-323-97	39.0850	77.0230	Northwest Br	PW	3	8735.05	8.89	50.26	39.52
MO-P-490-2-94	39.1937	77.1595	Goshen Br	PW	1	161.90	2.72	56.95	40.33
MO-P-490-3-94	39.1943	77.1619	Goshen Br	PW	1	205.20	2.34	52.53	45.13
MO-P-490-4-94	39.1934	77.1569	Goshen Br	PW	1	105.50	3.51	66.45	30.05
MO-P-495-312-96	39.2797	77.3125	Little Bennet Cr	MP	3	7877.27	1.76	48.31	48.42
MO-P-496-215-97	39.1330	77.4740	Broad Run	PW	2	807.40	1.18	69.35	22.84
MO-P-500-1-94	39.0437	77.1389	Old Farm Cr	PW	2	1460.60	53.04	15.38	30.73
MO-P-500-2-94	39.0397	77.1421	Old Farm Cr	PW	2	1742.70	51.26	13.90	34.13
MO-P-501-105-97	39.0260	77.1930	Un Trib To Cabin John Cr	PW	1	60.43	11.92	65.92	22.16
MO-P-501-1-94	39.0277	77.1931	Cabin John Cr	PW	1	47.90	14.20	60.96	24.84
MO-P-501-3-94	39.0270	77.1931	Cabin John Cr	PW	1	50.20	14.14	61.55	24.30
MO-P-508-2-94	39.1879	77.2271	Great Seneca Cr	PW	1	348.00	2.69	74.58	22.74
MO-P-508-3-94	39.1876	77.2246	Great Seneca Cr	PW	1	591.40	22.47	58.98	18.31
MO-P-514-116-97	39.1570	77.4330	Broad Run	PW	1	1085.49	0.03	78.20	17.28
PW-M-998-1-94	38.9454	77.1137	Little Falls	PW	1	1360.40	56.20	3.66	39.96
PW-M-998-2-94	38.9453	77.1128	Little Falls	PW	1	1352.50	56.47	3.63	39.75
PW-M-999-3-94	38.9405	77.1211	Little Falls	PW	2	4434.70	61.89	6.18	31.33
PW-M-999-4-94	38.9412	77.1213	Little Falls	PW	2	4425.50	62.02	6.19	31.19

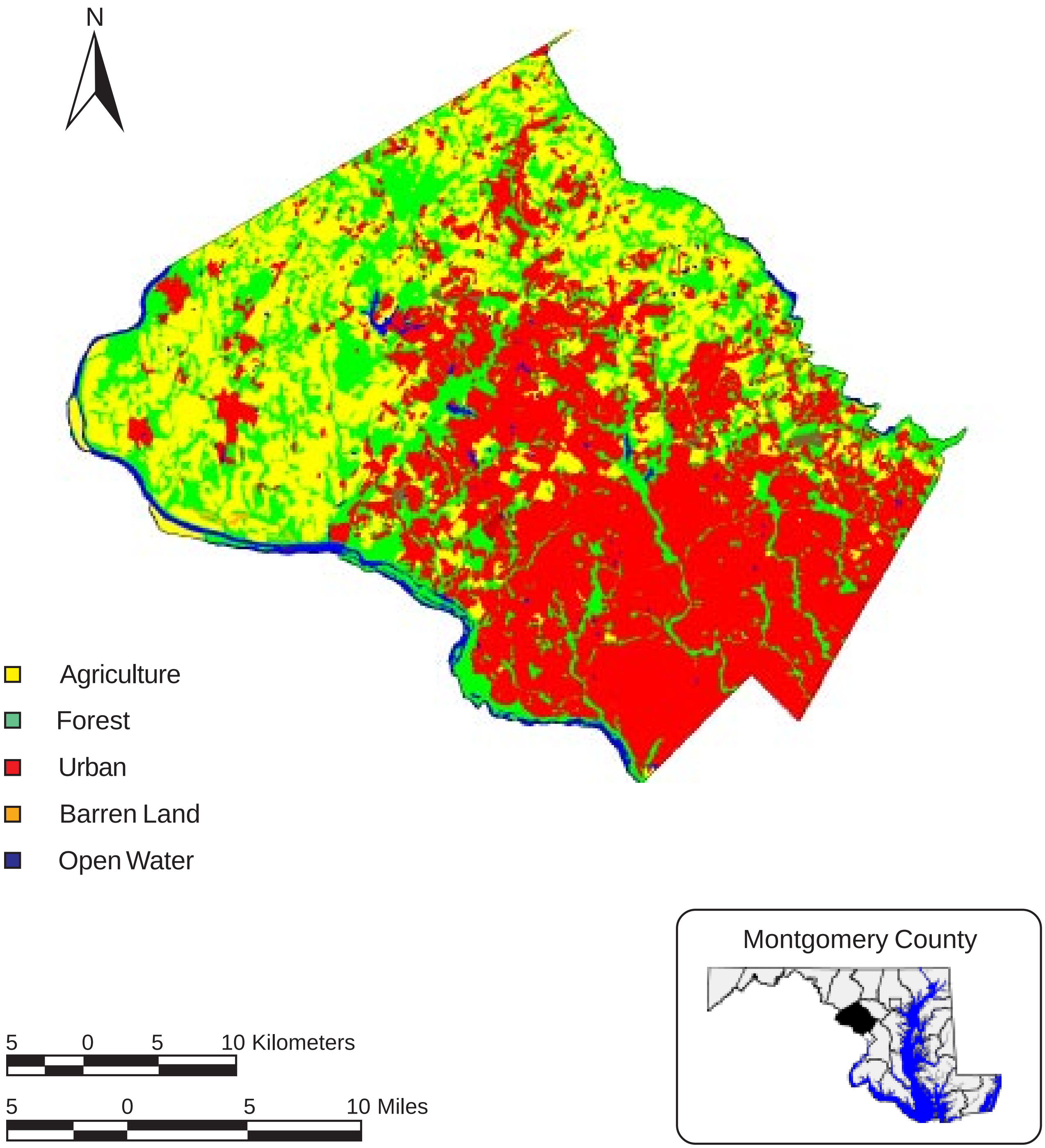

Figure 1. Land use in Montgomery County (MOP 1994).

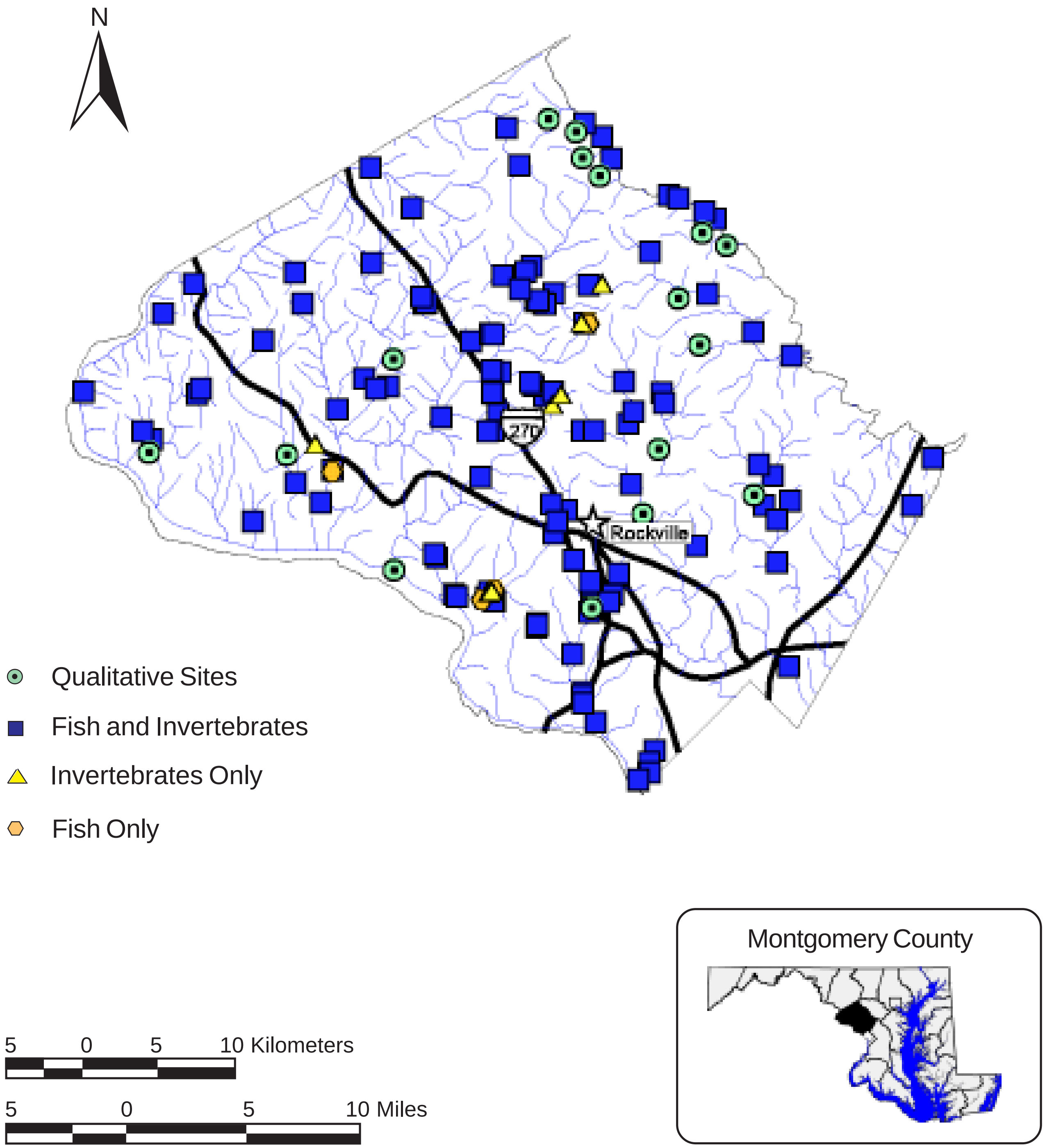

Figure 2. Location of Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Table 2. Percent occurrence of fish species collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Family	Common Name	Scientific Name	Number of Occurrences	Percent Occurrence
Anguillidae	American eel	*Anguilla rostrata*	30	24.39
Cyprinidae	central stoneroller	*Campostoma anomalum*	53	43.09
	goldfish	*Carassius auratus*	1	0.81
	rosyside dace	*Clinostomus funduloides*	74	60.16
	satinfin shiner	*Cyprinella analostana*	10	8.13
	spotfin shiner	*Cyprinella spiloptera*	3	2.44
	cutlips minnow	*Exoglossum maxillingua*	45	36.59
	eastern silvery minnow	*Hybognathus regius*	1	0.81
	common shiner	*Luxilus cornutus*	48	39.02
	river chub	*Nocomis micropogon*	12	9.76
	golden shiner	*Notemigonus crysoleucas*	14	11.38
	silverjaw minnow	*Notropis buccatus*	36	29.27
	spottail shiner	*Notropis hudsonius*	9	7.32
	swallowtail shiner	*Notropis procne*	28	22.76
	rosyface shiner	*Notropis rubellus*	1	0.81
	bluntnose minnow	*Pimephales notatus*	40	32.52
	fathead minnow	*Pimephales promelas*	4	3.25
	blacknose dace	*Rhinichthys atratulus*	106	86.18
	longnose dace	*Rhinichthys cataractae*	71	57.72
	creek chub	*Semotilus atromaculatus*	101	82.11
	fallfish	*Semotilus corporalis*	22	17.89
Catostomidae	white sucker	*Catostomus commersoni*	87	70.73
	creek chubsucker	*Erimyzon oblongus*	11	8.94
	northern hogsucker	*Hypentelium nigricans*	30	24.39
	golden redhorse	*Moxostoma erythrurum*	2	1.63
	shorthead redhorse	*Moxostoma macrolepidotum*	3	2.44
Ictaluridae	white catfish	*Ameiurus catus*	1	0.81
	yellow bullhead	*Ameiurus natalis*	27	21.95
	brown bullhead	*Ameiurus nebulosus*	7	5.69
	margined madtom	*Noturus insignis*	13	10.57
Umbridae	eastern mudminnow	*Umbra pygmaea*	1	0.81
Salmonidae	rainbow trout	*Oncorhynchus mykiss*	7	5.69
	brown trout	*Salmo trutta*	10	8.13
Poeciliidae	mosquitofish	*Gambusia affinis*	2	1.63
Cottidae	mottled sculpin	*Cottus bairdi*	28	22.76
	Potomac sculpin	*Cottus girardi*	41	33.33
Centrarchidae	rock bass	*Ambloplites rupestris*	9	7.32
	redbreast sunfish	*Lepomis auritus*	43	34.96
	green sunfish	*Lepomis cyanellus*	55	44.72
	pumpkinseed	*Lepomis gibbosus*	33	26.83
	bluegill	*Lepomis machrochirus*	38	30.89
	smallmouth bass	*Micropterus dolomieu*	21	17.07
	largemouth bass	*Micropterus salmoides*	24	19.51
Percidae	greenside darter	*Etheostoma blennioides*	26	21.14
	fantail darter	*Etheostoma flabellare*	55	44.72
	tessellated darter	*Etheostoma olmstedi*	53	43.09
	yellow perch	*Perca flavescens*	1	0.81
	shield darter	*Percina peltata*	7	5.69
None			8	6.50

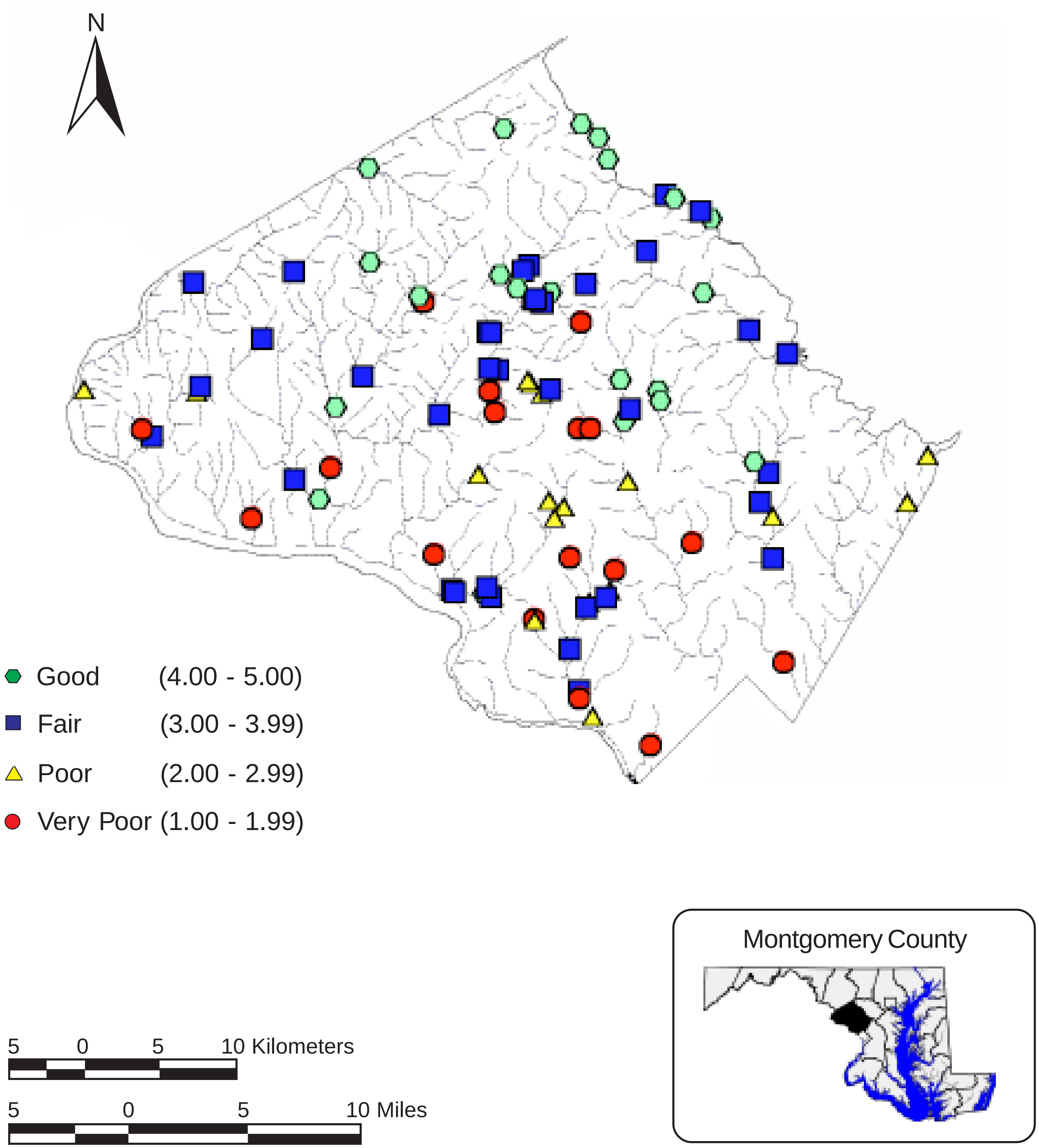

Figure 3. Stream ecological conditions based on the Fish Index of Biotic Integrity (F-IBI) at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Table 3. Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
Nematomorpha[3]						bu	6.33
Enopla	Hoplonemertea	Tetrastemmatidae			Predator		1.27
			Prostoma Sp.		Predator		1.27
Turbellaria				4	Predator	sp	2.53
Turbellaria	Tricladida	Planariidae	*Dugesia* Sp.	7	Predator	sp	8.86
Oligochaeta	Lumbriculida	Lumbriculidae		10	Collector	bu	17.72
Oligochaeta	Tubificida	Enchytraeidae		10	Collector	bu	10.13
		Naididae		10	Collector	bu	53.16
		Tubificidae		10	Collector	cn	22.78
			Limnodrilus Sp.	10	Collector	cn	2.53
			Spirosperma Sp.	10	Collector	cn	1.27
Hirudinea	Rhynchobdellida	Glossiphoniidae	*Helobdella* Sp.		Predator	sp	1.27
Gastropoda	Basommatophora	Ancylidae	*Fissia* Sp.	7	Scraper	cb	3.80
		Lymnaeidae		6	Scraper	cb	1.27
			Pseudosuccinea Sp.	6	Collector	cb	1.27
		Physidae	*Physella* Sp.	8	Scraper	cb	7.59
		Planorbidae	*Menetus* Sp.	8	Scraper	cb	1.27
Pelecypoda	Veneroida	Corbiculidae	*Corbicula* Sp.	6	Filterer	bu	2.53
		Sphaeriidae			Filterer	bu	1.27
			Pisidium Sp.	8	Filterer	bu	7.59
			Sphaerium Sp.	8	Filterer	bu	3.80
Malacostraca	Amphipoda					sp	2.53
		Crangonyctidae	*Crangonyx* Sp.	4	Collector	sp	16.46
		Gammaridae	*Gammarus* Sp.	6	Shredder	sp	1.27
			Stygonectes Sp.	6	Shredder	sp	2.53
Malacostraca	Isopoda	Asellidae	*Caecidotea* Sp.	8	Collector	sp	5.06
Insecta	Collembola						5.06
		Isotomidae	*Isotomurus* Sp.				1.27
Insecta	Ephemeroptera	Ameletidae	*Ameletus* Sp.	0	Collector	sw, cb	15.19
		Baetidae			Collector	sw, cn	7.59
			Acentrella Sp.	4	Collector	sw, cn	3.80
			Acerpenna Sp.	4	Collector	sw, cn	13.92
			Baetis Sp.	6	Collector	sw, cb, cn	11.39
			Centroptilum Sp.	2	Collector	sw, cn	2.53
		Caenidae	*Caenis* Sp.	7	Collector	sp	3.80
		Ephemerellidae	*Drunella* Sp.	1	Scraper	cn, sp	5.06
			Ephemerella Sp.	2	Collector	cn, sw	41.77
			Eurylophella Sp.	4	Scraper	cn, sp	10.13
			Satella Sp.	2	Collector	cn	5.06
		Heptageniidae			Scraper	cn	1.27
			Epeorus Sp.	0	Scraper	cn	6.33
			Heptagenia Sp.	4	Scraper	cn, sw	1.27
			Stenacron Sp.	4	Collector	cn	2.53
			Stenonema Sp.	4	Scraper	cn	34.18
		Isonychiidae	*Isonychia* Sp.	2	Filterer	sw, cn	13.92
		Leptophlebiidae			Collector	sw, cn	1.27
			Leptophlebia Sp.	4	Collector	sw, cn, sp	3.80

Table 3 (cont.). Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
			Paraleptophlebia Sp.	2	Collector	sw, cn, sp	15.19
		Siphlonuridae	*Siphlonurus* Sp.	7	Collector	sw, cb	1.27
Insecta	Odonata	Aeshnidae	*Boyeria* Sp.	2	Predator	cb, sp	2.53
		Calopterygidae	*Calopteryx* Sp.	6	Predator	cb	2.53
		Coenagrionidae	*Argia* Sp.	8	Predator	cn, cb, sp	1.27
		Cordulegastridae	*Cordulegaster* Sp.	3	Predator	bu	1.27
		Gomphidae			Predator	bu	1.27
			Lanthus Sp.	6	Predator	bu	1.27
			Stylogomphus Sp.		Predator	bu	1.27
Insecta	Plecoptera	Capniidae			Shredder	sp, cn	2.53
			Allocapnia Sp.	3	Shredder	cn	6.33
			Paracapnia Sp.	1	Shredder	-	2.53
		Chloroperlidae	*Perlinella* Sp.		Predator	cn	1.27
		Leuctridae			Shredder	sp, cn	5.06
			Leuctra Sp.	0	Shredder	cn	8.86
		Nemouridae			Shredder	sp, cn	5.06
			Amphinemura Sp.	3	Shredder	sp, cn	48.10
			Ostrocerca Sp.		Shredder	sp, cn	2.53
			Prostoia Sp.		Shredder	sp, cn	31.65
		Perlidae			Predator	cn	6.33
			Acroneuria Sp.	0	Predator	cn	3.80
			Eccoptura Sp.		Predator	cn	2.53
		Perlodidae			Predator	cn	10.13
			Clioperla Sp.	1	Predator	cn	6.33
			Isoperla Sp.	2	Predator	cn, sp	3.80
		Taeniopterygidae	*Strophopteryx* Sp.		Shredder	sp, cn	7.59
Insecta	Hemiptera	Corixidae			Predator	sw	1.27
		Veliidae	*Microvelia* Sp.	6	Predator	skater	1.27
Insecta	Megaloptera	Corydalidae	*Corydalus* Sp.	5	Predator	cn, cb	2.53
			Nigronia Sp.	0	Predator	cn, cb	1.27
		Sialidae	*Sialis* Sp.	4	Predator	bu, cb, cn	2.53
Insecta	Trichoptera	Glossosomatidae	*Agapetus* Sp.	2	Scraper	cn	2.53
			Glossosoma Sp.	0	Scraper	cn	3.80
		Hydropsychidae			Filterer	cn	2.53
			Cheumatopsyche Sp.	5	Filterer	cn	48.10
			Diplectrona Sp.	2	Filterer	cn	17.72
			Hydropsyche Sp.	6	Filterer	cn	45.57
		Hydroptilidae	*Hydroptila* Sp.	6	Scraper	cn	1.27
		Lepidostomatidae	*Lepidostoma* Sp.	3	Shredder	cb, sp, cn	1.27
		Limnephilidae			Shredder	cb, sp, cn	3.80
			Hydatophylax Sp.	2	Shredder	sp, cb	1.27
			Ironoquia Sp.	3	Shredder	sp	2.53
			Pycnopsyche Sp.	4	Shredder	sp, cb, cn	1.27
		Philopotamidae			Filterer	cn	1.27
			Chimarra Sp.	4	Filterer	cn	12.66
			Dolophilodes Sp.	0	Filterer	cn	7.59
		Polycentropodidae	*Polycentropus* Sp.	5	Filterer	cn	5.06

Table 3 (cont.). Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
		Psychomyiidae	*Lype* Sp.	2	Scraper	cn	1.27
		Rhyacophilidae	*Rhyacophila* Sp.	1	Predator	cn	10.13
		Uenoidae	*Neophylax* Sp.	3	Scraper	cn	21.52
Insecta	Coleoptera	Dryopidae	*Helichus* Sp.	5	Scraper	cn	2.53
		Dytiscidae	*Agabus* Sp.	5	Predator	sw, dv	5.06
			Hydroporus Sp.	5	Predator	sw, cb	1.27
		Elmidae	*Ancyronyx* Sp.	2	Scraper	cn, sp	5.06
			Dubiraphia Sp.	6	Scraper	cn, cb	7.59
			Optioservus Sp.	4	Scraper	cn	24.05
			Oulimnius Sp.	2	Scraper	cn	32.91
			Stenelmis Sp.	6	Scraper	cn	22.78
		Haliplidae	*Peltodytes* Sp.	5	Shredder	cb, cn	1.27
		Hydrophilidae	*Hydrobius* Sp.	5	Collector	cb, cn, sp	1.27
		Psephenidae	*Psephenus* Sp.	4	Scraper	cn	2.53
		Ptilodactylidae	*Anchytarsus* Sp.	4	Shredder	cn	6.33
Insecta	Diptera	Ceratopogonidae	*Bezzia* Sp.	6	Predator	bu	1.27
			Ceratopogon Sp.	6	Predator	sp, bu	6.33
			Culicoides Sp.	10	Predator	bu	3.80
			Probezzia Sp.	6	Predator	bu	3.80
		Chironomidae	*Brillia* Sp.	5	Shredder	bu, sp	20.25
			Cardiocladius Sp.	6	Predator	bu, cn	1.27
			Chaetocladius Sp.	6	Collector	sp	1.27
			Conchapelopia Sp.	6	Predator	sp	45.57
			Corynoneura Sp.	7	Collector	sp	17.72
			Cricotopus Sp.	7	Shredder	cn, bu	7.59
			Cricotopus/ Orthocladius Sp.		Shredder	78.48	
			Cryptochironomus Sp.	8	Predator	sp, bu	6.33
			Diamesa Sp.	5	Collector	sp	45.57
			Dicrotendipes Sp.	10	Collector	bu	1.27
			Diplocladius Sp.	7	Collector	sp	3.80
			Endochironomus Sp.	10	Shredder	cn	2.53
			Eukiefferiella Sp.	8	Collector	sp	56.96
			Heleniella Sp.		Predator	sp	2.53
			Heterotrissocladius Sp.		Collector	sp, bu	2.53
			Hydrobaenus Sp.	8	Scraper	sp	3.80
			Krenopelopia Sp.		Predator	sp	1.27
			Meropelopia Sp.	7			2.53
			Micropsectra Sp.	7	Collector	cb, sp	8.86
			Microtendipes Sp.	6	Filterer	cn	6.33
			Nanocladius Sp.	3	Collector	sp	8.86
			Natarsia Sp.	8	Predator	sp	2.53
			Orthocladiinae A Sp.		Collector		39.24
			Orthocladius Sp.	6	Collector	sp, bu	16.46
			Parachaetocladius Sp.	2	Collector	sp	1.27
			Paramerina Sp.	4	Predator	sp	1.27
			Parametriocnemus Sp.	5	Collector	sp	60.76

Table 3 (cont.). Tolerance Value (TV)[1], Functional Feeding Group (FFG), Habit, and Percent Occurrence of benthic macroinvertebrate taxa[2] collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations of habits are as follows: bu - burrower, cn - clinger, cb - climber, sp - sprawler, dv - diver, and sk - skater.

Class	Order	Family	Genus	TV	FFG	Habit	Percent Occurrence
			Paratanytarsus Sp.	6	Collector	sp	16.46
			Polypedilum Sp.	6	Shredder	cb, cn	44.30
			Potthastia Sp.	2	Collector	sp	1.27
			Pseudorthocladius Sp.	0	Collector	sp	1.27
			Rheocricotopus Sp.	6	Collector	sp	20.25
			Rheotanytarsus Sp.	6	Filterer	cn	21.52
			Stempellinella Sp.	4	Collector	cb, sp, cn	3.80
			Stenochironomus Sp.	5	Shredder	bu	1.27
			Stictochironomus Sp.	9	Collector	bu	1.27
			Symposiocladius Sp.		Predator	sp	2.53
			Sympotthastia Sp.	2	Collector	sp	16.46
			Tanytarsus Sp.	6	Filterer	cb, cn	21.52
			Thienemanniella Sp.	6	Collector	sp	36.71
			Thienemannimyia Sp.		Predator	sp	27.85
			Tribelos Sp.	5	Collector	bu	1.27
			Trissopelopia Sp.		Predator	sp	18.99
			Tvetenia Sp.	5	Collector	sp	6.33
			CHIRONOMINI	6	Collector		1.27
			ORTHOCLADIINAE		Collector		2.53
			TANYPODINAE		Predator		1.27
			TANYTARSINI		Collector		2.53
			Unniella Sp.		Collector	-	2.53
			Zavrelimyia Sp.	8	Predator	sp	11.39
		Dixidae	*Dixa* Sp.	4	Predator	sw, cb	1.27
		Dolichopodidae		4	Predator	sp, bu	1.27
		Empididae	*Chelifera* Sp.		Predator	sp, bu	13.92
			Clinocera Sp.		Predator	cn	31.65
			Hemerodromia Sp.	6	Predator	sp, bu	25.32
		Simuliidae		7	Filterer	cn	5.06
			Prosimulium Sp.	7	Filterer	cn	49.37
			Simulium Sp.	7	Filterer	cn	35.44
			Stegopterna Sp.	7	Filterer	cn	15.19
		Tabanidae	*Chrysops* Sp.	7	Predator	sp, bu	1.27
		Tipulidae			Predator	bu, sp	1.27
			Antocha Sp.	5	Collector	cn	29.11
			Dicranota Sp.	4	Predator	sp, bu	12.66
			Hexatoma Sp.	4	Predator	bu, sp	5.06
			Ormosia Sp.		Collector	bu	2.53
			Pseudolimnophila Sp.	2	Predator	bu	2.53
			Tipula Sp.	4	Shredder	bu	24.05

[1] Tolerance values are on a 0 (extremely sensitive) to 10 (tolerant) scale.
[2] Taxa not identified to genus are presented in capital letters. Subfamily - Tanypodinae, Orthocladiinae; Tribe - Chironomini, Tanytarsini.
[3] Nematomorpha is a phylum level identification. No further identification was made.

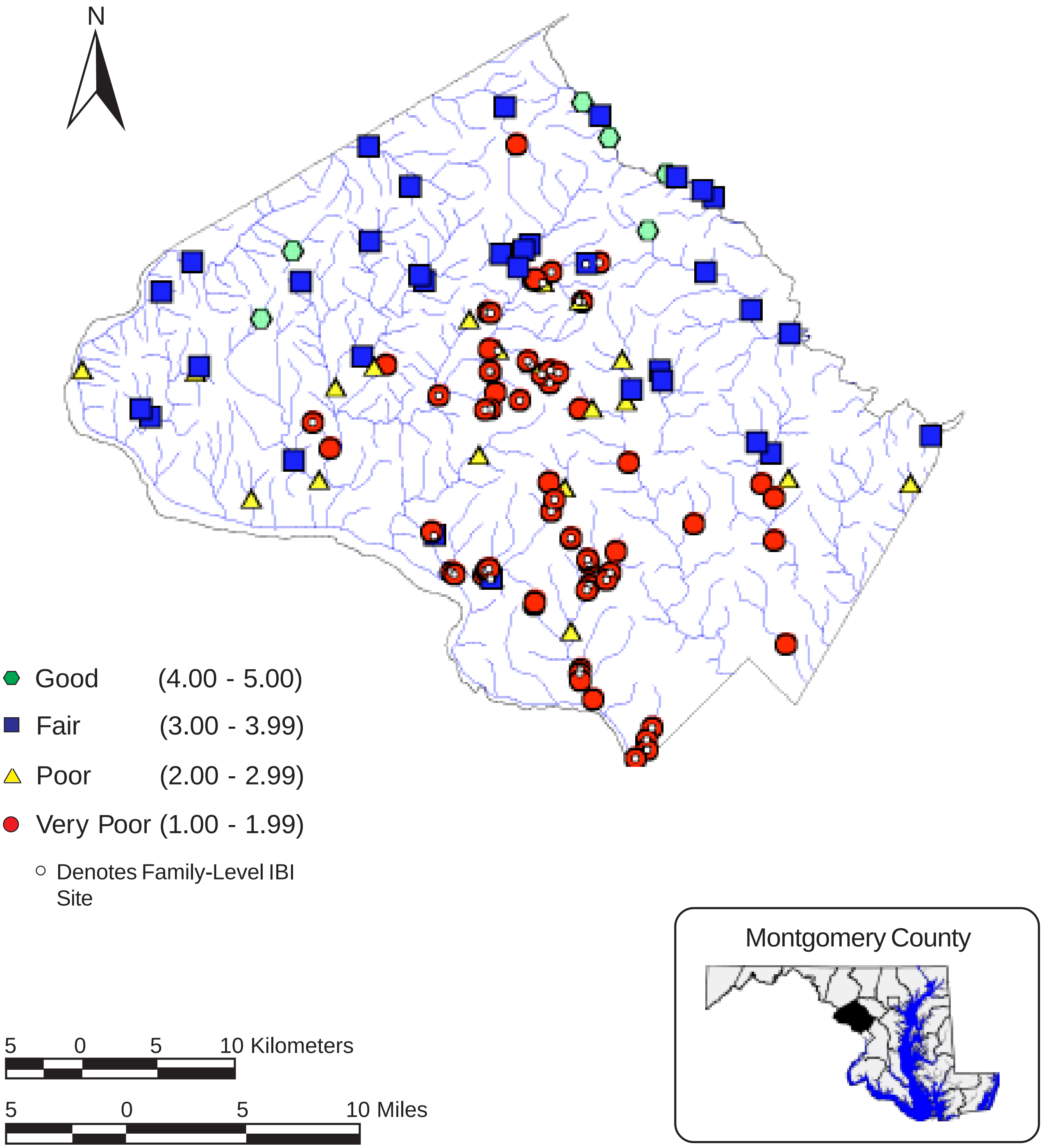

Figure 4. Stream ecological conditions based on the Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI) at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Table 4. Percent occurrence of reptile and amphibian species collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Family	Common Name	Scientific Name	Number of Occurrences	Percent Occurrence
Plethodontidae	eastern mud salamander	*Pseudotriton m. montanus*	3	2.44
	northern dusky salamander	*Desmognathus f. fuscus*	48	39.02
	northern two-lined salamander	*Eurycea bislineata*	63	51.22
	northern spring salamander	*Gyrinophilus p. porphyriticus*	1	0.81
	red salamander	*Pseudotriton ruber*	12	9.76
	redback salamander	*Plethodon cinereus*	6	4.88
Bufonidae	American toad	*Bufo americanus*	20	16.26
	Fowler's toad	*Bufo woodhousii fowleri*	1	0.81
Hylidae	northern spring peeper	*Pseudacris c. crucifer*	1	0.81
Ranidae	bullfrog	*Rana catesbeiana*	32	26.02
	green frog	*Rana clamitans melanota*	41	33.33
	northern leopard frog	*Rana pipiens*	9	7.32
	pickerel frog	*Rana palaustris*	13	10.57
	wood frog	*Rana sylvatica*	11	8.94
Chelydridae	common snapping turtle	*Chelydra serpentina*	6	4.88
Kinosternidae	common musk turtle	*Sternotherus odoratus*	1	0.81
Emydidae	eastern box turtle	*Terrapene c. carolina*	14	11.38
	eastern painted turtle	*Chrysemys p. picta*	2	1.63
	spotted turtle	*Clemmys guttata*	1	0.81
Colubridae	black rat snake	*Elaphe o. obsoleta*	2	1.63
	eastern garter snake	*Thamnophis s. sirtalis*	2	1.63
	northern ringneck snake	*Diadophis punctatus edwardsii*	2	1.63
	northern water snake	*Nerodia s. sipedon*	12	9.76
	queen snake	*Regina septemvittata*	1	0.81
None			13	10.57

Table 5. Physical habitat data for Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	Instream Habitat[1]	Epifaunal Substrate[1]	Velocity/Depth Diversity[1]	Pool Quality[1]	Riffle Quality[1]	Percent Embeddedness[1]	Percent Shading[1]	Maximum Depth (cm)[1]	Number of Woody Debris	Number of Rootwads	Percent Channel Flow[1]	Channel Alteration[1]	Bank Stability[1]	Riparian Width (m)[1]	Aesthetic Rating[1]
HO-P-132-312-97	14	14	13	17	13	15	65	87	1	3	80	12	8	50	16
HO-P-132-319-97	12	11	15	19	13	40	60	134	5	0	90	11	10	50	16
HO-P-194-310-97	18	17	13	14	14	25	75	98	3	1	50	10	8	50	16
HO-P-214-311-97	15	15	13	14	11	20	90	78	0	1	50	11	7	50	16
MO-P-001-214-97	15	17	12	14	13	35	75	73	0	1	80	11	11	0	10
MO-P-006-1-94	8	3	14	17	12	45	40	85	1		95	11	4	50	13
MO-P-006-2-94	6	1	13	16	11	40	5	66	0		80	1	2	0	2
MO-P-014-107-97	10	5	11	16	3	25	55	74	0	1	40	5	16	0	12
MO-P-016-227-97	13	11	10	10	6	40	85	42	1	0	80	6	18	50	17
MO-P-022-3-94	3	3	2	16	0	50	90	37	0		50	15	3	50	18
MO-P-022-6-94	3	3	3	16	0	50	85		0		40	12	4	50	18
MO-P-024-307-97	14	5	13	15	14	20	85	62	1	1	85	19	16	0	16
MO-P-024-315-97	19	5	10	20	0	35	70	112	3	2	98	5	10	0	16
MO-P-025-1-94	11	6	7	16	8	20	90	42	0		70	6	4	9	1
MO-P-025-2-94	5	4	11	16	6	80	40	76	1		95	5	3	0	1
MO-P-035-227-97	14	16	15	16	15	35	90	127	2	2	88	6	5	50	12
MO-P-038-1-94	16	12	14	17	16	10	85	97	5		65	4	5	50	11
MO-P-038-3-94	8	2	11	13	14	30	75	59	0		85	6	4	50	10
MO-P-053-2-94	5	3	9	11	11	35	80	62	0		85	13	2	50	12
MO-P-053-7-94	9	3	12	16	11	50	92	70	2		97	16	3	50	12
MO-P-056-319-97	16	6	14	18	11	35	50	79	4	1	65	5	5	0	16
MO-P-059-320-97	11	11	15	16	11	40	45	95	7	1	85	13	6	50	16
MO-P-064-328-97	14	16	12	16	12	25	70	64	0	0	65	15	15	50	16
MO-P-069-5-94	14	8	13	17	6	25	95	70	0		85	8	6	50	0
MO-P-082-124-97	17	11	14	18	7	35	97	84	6	2	80	9	10	50	12
MO-P-086-1-94	15	12	13	16	12	40	95	91	4		65	5	3	50	15
MO-P-086-2-94	9	11	15	17	11	10	75	78	5		60	4	5	50	10
MO-P-091-204-97	17	13	14	16	12	40	55	68	2	1	92	8	7	50	15
MO-P-099-1-94	6	5	11	11	6	35	90	52	1		6	5	2	50	12
MO-P-099-2-94	7	5	11	12	7	35	75	51	0		75	6	2	50	12
MO-P-101-126-97	15	11	12	15	11	20	70	86	1	1	80	7	16	50	8
MO-P-102-308-97	17	18	12	15	12	25	70	63	1	0	60	18	19	5	16
MO-P-103-1-94	17	12	11	11	8	10	95	50	2		75	7	5	50	14
MO-P-103-2-94	17	16	11	11	8	15	97	62	2		70	7	9	50	16
MO-P-108-123-97	16	15	13	16	8	30	85	82	0	0	65	4	19	0	12
MO-P-110-223-97	16	5	12	10	15	45	50	67	0	0	85	4	19	0	5

Table 5 (cont.). Physical habitat data for Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	Instream Habitat[1]	Epifaunal Substrate[1]	Velocity/Depth Diversity[1]	Pool Quality[1]	Riffle Quality[1]	Percent Embeddedness[1]	Percent Shading[1]	Maximum Depth (cm)[1]	Number of Woody Debris	Number of Rootwads	Percent Channel Flow[1]	Channel Alteration[1]	Bank Stability[1]	Riparian Width (m)[1]	Aesthetic Rating[1]
MO-P-111-136-96	12	14	12	11	8	35	80	61	0	2	60	8	7	50	16
MO-P-118-1-94	13	3	15	19	16	50	75	127	6		95	9	5	50	14
MO-P-118-2-94	8	5	14	14	17	55	40	86	0		85	6	3	50	16
MO-P-126-206-97	12	15	14	16	14	10	90	73	1	4	85	14	5	42	19
MO-P-128-118-97	10	15	8	8	7	20	85	24	0	0	85	16	18	0	9
MO-P-129-114-97	10	12	9	6	6	15	95	36	0	0	50	18	15	23	16
MO-P-129-119-97	13	10	11	15	7	30	70	70	1	2	80	15	17	0	16
MO-P-129-131-97	11	16	8	4	10	15	90	20	0	0	80	19	10	50	18
MO-P-153-113-97	13	15	9	8	7	20	95	33	5	2	70	18	12	22	20
MO-P-159-110-97	11	11	7	11	6	65	95	43	4	1	95	18	14	11	15
MO-P-180-1-94	12	5	13	17	11	10	75	100	5		50	6	3	50	17
MO-P-180-3-94	13	5	13	20	12	20	75	160	4		65	3	4	50	11
MO-P-182-325-97	12	8	14	16	8	40	80	103	5	1	55	12	7	0	16
MO-P-190-302-97	16	16	12	18	10	35	50	88	0	1	70	15	18	0	15
MO-P-192-1-94	16	12	6	7	7	15	80	39	0		65	11	7	0	13
MO-P-192-2-94	16	11	6	11	7	15	85	42	0		50	8	8	8	13
MO-P-204-137-97	12	17	9	10	12	20	95	34	4	0	45	9	8	50	16
MO-P-206-311-97	12	5	12	12	6	45	75	84	4	2	60	9	5	50	18
MO-P-213-205-97	16	17	15	14	15	10	95	92	4	3	90	13	7	50	15
MO-P-233-1-94	12	12	16	16	16	40	85	86	3		85	6	6	50	16
MO-P-233-2-94	11	10	13	16	0	10	75	100	3		80	5	5	50	18
MO-P-245-303-97	10	7	11	16	11	75	94	73	3	2	98	16	7	50	17
MO-P-248-125-96	12	14	12	12	14	35	78	51	0	2	75	10	7	50	16
MO-P-251-115-97	12	12	7	5	7	35	95	18	0	0	100	17	19	0	15
MO-P-252-323-97	15	17	14	15	16	10	65	150	1	2	85	12	7	50	14
MO-P-258-213-97	15	17	10	11	15	0	99	46	0	1	65	16	16	50	16
MO-P-265-4-94	16	5	6	1	6	25	20	19	0		95	18	5	50	16
MO-P-265-5-94	0	1	1	2	0	100	80	18	0		80	5	18	50	19
MO-P-269-203-97	15	11	14	16	14	35	70	80	1	1	85	1	18	0	8
MO-P-276-211-97	16	17	15	18	9	20	95	92	5	1	60	14	12	50	17
MO-P-286-1-94	7	5	13	16	14	10	50	90	1		90	11	4	50	8
MO-P-286-2-94	11	5	11	20	11	80	75	152	0		95	14	5	10	6
MO-P-296-1-94	8	3	12	16	6	65	60	108	2		95	5	4		6
MO-P-296-2-94	6	5	11	16	6	65	50	84	1		70	2	5	0	7
MO-P-304-127-97	12	14	10	13	9	30	55	47	2	1	45	13	5	50	12
MO-P-308-117-97	14	16	10	7	11	25	95	42	0	0	50	18	6	12	4

Table 5 (cont.). Physical habitat data for Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	Instream Habitat[1]	Epifaunal Substrate[1]	Velocity/Depth Diversity[1]	Pool Quality[1]	Riffle Quality[1]	Percent Embeddedness[1]	Percent Shading[1]	Maximum Depth (cm)[1]	Number of Woody Debris	Number of Rootwads	Percent Channel Flow[1]	Channel Alteration[1]	Bank Stability[1]	Riparian Width (m)[1]	Aesthetic Rating[1]
MO-P-310-313-97	13	11	9	8	14	25	70	48	1	3	80	16	16	50	11
MO-P-311-112-97	13	11	11	15	6	15	80	50	3	3	85	16	15	37	18
MO-P-316-205-97	15	14	12	13	9	20	65	53	0	1	85	16	8	50	5
MO-P-325-208-97	13	11	11	14	10	25	95	67	1	2	90	7	10	50	18
MO-P-325-216-97	15	10	15	18	9	50	80	118	1	1	95	6	5	50	16
MO-P-333-207-97	10	15	11	12	13	45	80	55	1	0	95	16	16	50	18
MO-P-333-224-97	11	11	13	8	14	25	65	78	1	1	75	16	17	50	16
MO-P-361-8-94	11	5	11	11	8	20	90	120	2		80	13	5	50	16
MO-P-366-212-97	13	15	9	9	9	20	80	49	0	1	80	18	18	50	19
MO-P-370-308-97	13	15	14	16	14	17	50	124	10	6	86	15	6	50	16
MO-P-407-225-97	16	9	12	14	12	40	25	96	0	0	90	11	16	0	15
MO-P-419-2-94	3	1	6	10	11	50	30	35	0		95	17	10	50	16
MO-P-428-106-97	15	16	10	8	13	20	75	44	0	2	50	15	17	20	13
MO-P-432-1-94	17	16	12	14	13	45	72	125	0		80	5	5	0	5
MO-P-432-2-94	5	2	10	18	6	15	20	132	1		30	0	1	50	1
MO-P-436-226-97	5	6	7	3	6	45	45	19	0	0	50	4	17	0	15
MO-P-437-206-97	16	16	13	16	16	40	75	89	2	2	95	16	10	50	17
MO-P-437-210-97	15	8	12	11	15	25	90	63	1	1	100	15	11	50	16
MO-P-445-318-97	16	11	16	18	11	35	75	102	4	1	90	12	15	10	16
MO-P-452-1-94	9	15	7	11	6	40	95	57	1		60	14	9	0	2
MO-P-452-2-94	7	5	8	16	6	50	97	43	1		95	15	4	0	2
MO-P-454-3-94	18	3	14	15	14	25	95	86	4		80	5	6	50	19
MO-P-468-109-97	15	13	9	12	7	20	85	41	1	2	50	11	13	50	8
MO-P-470-1-94	11	5	13	18	6	40	65	78	3		97	5	5	50	7
MO-P-470-2-94	5	4	12	16	10	50	97	88	3		95	4	3	13	4
MO-P-474-317-97	14	14	13	10	16	35	85	45	0	0	85	17	14	23	18
MO-P-478-312-97	18	17	14	12	17	30	50	54	1	0	65	12	18	17	16
MO-P-480-2-94	17	18	17	14	20	35	50	88	0		95	13	17	0	4
MO-P-480-3-94	18	17	11	11	18	20	92	63	0		85	18	5	50	10
MO-P-480-326-97	12	11	10	16	9	35	90	48	0	0	100	2	20	12	5
MO-P-481-101-97	13	5	11	13	8	0	95	51	1	1	65	17	14	50	15
MO-P-488-1-94	11	11	14	18	8	35	70	82	2		35	3	5	50	15
MO-P-488-2-94	11	11	14	18	6	65	80	104	2		70	4	3	50	5
MO-P-489-314-97	17	9	11	18	6	40	85	78	6	3	95	14	13	50	16
MO-P-489-323-97	12	7	12	16	10	35	75	63	1	1	85	5	4	50	16
MO-P-490-2-94	16	5	7	11	7	55	90	30	2		70	8	6	0	6

Table 5 (cont.). Physical habitat data for Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	Instream Habitat[1]	Epifaunal Substrate[1]	Velocity/Depth Diversity[1]	Pool Quality[1]	Riffle Quality[1]	Percent Embeddedness[1]	Percent Shading[1]	Maximum Depth (cm)[1]	Number of Woody Debris	Number of Rootwads	Percent Channel Flow[1]	Channel Alteration[1]	Bank Stability[1]	Riparian Width (m)[1]	Aesthetic Rating[1]
MO-P-490-4-94	6	2	6	8	7	55	95	60	2		45	4	14	50	16
MO-P-495-312-96	13	18	18	15	17	5	90	110	4	5	80	10	8	41	16
MO-P-496-215-97	11	5	10	12	6	25	95	42	0	1	85	7	10	21	16
MO-P-500-1-94	16	15	13	14	10	50	80	102	2		60	11	5	2	3
MO-P-500-2-94	15	10	14	17	6	40	95	70	2		67	6	4	0	14
MO-P-501-1-94	3	1	3	6	0	65	60	26	0		45	14	11	1	16
MO-P-501-105-97	8	8	2	6	0	20	50	38	0	0	70	9	17	7	15
MO-P-501-3-94	5	1	5	12	1	60	45	41	0		70	16	4	0	16
MO-P-508-2-94	12	5	7	7	6	25	90	30	0		70	11	10	50	6
MO-P-508-3-94	15	5	11	13	10	25	95	62	3		70	3	2	50	5
MO-P-514-116-97	10	10	7	6	5	20	95	42	0	0	50	12	15	50	16
PW-M-998-1-94	2	2	13	15	13	50	95	82	0		99	0	19	0	16
PW-M-998-2-94	16	16	7	11	11	100	30	32	0		100	1	18	0	11
PW-M-999-3-94	18	16	17	16	17	5	65	80	0		95	16	12	4	4
PW-M-999-4-94	18	18	17	13	20	0	85	82	1		95	19	13	50	5

[1] MBSS Qualitative Habitat Metric - See Appendix B for Guidance

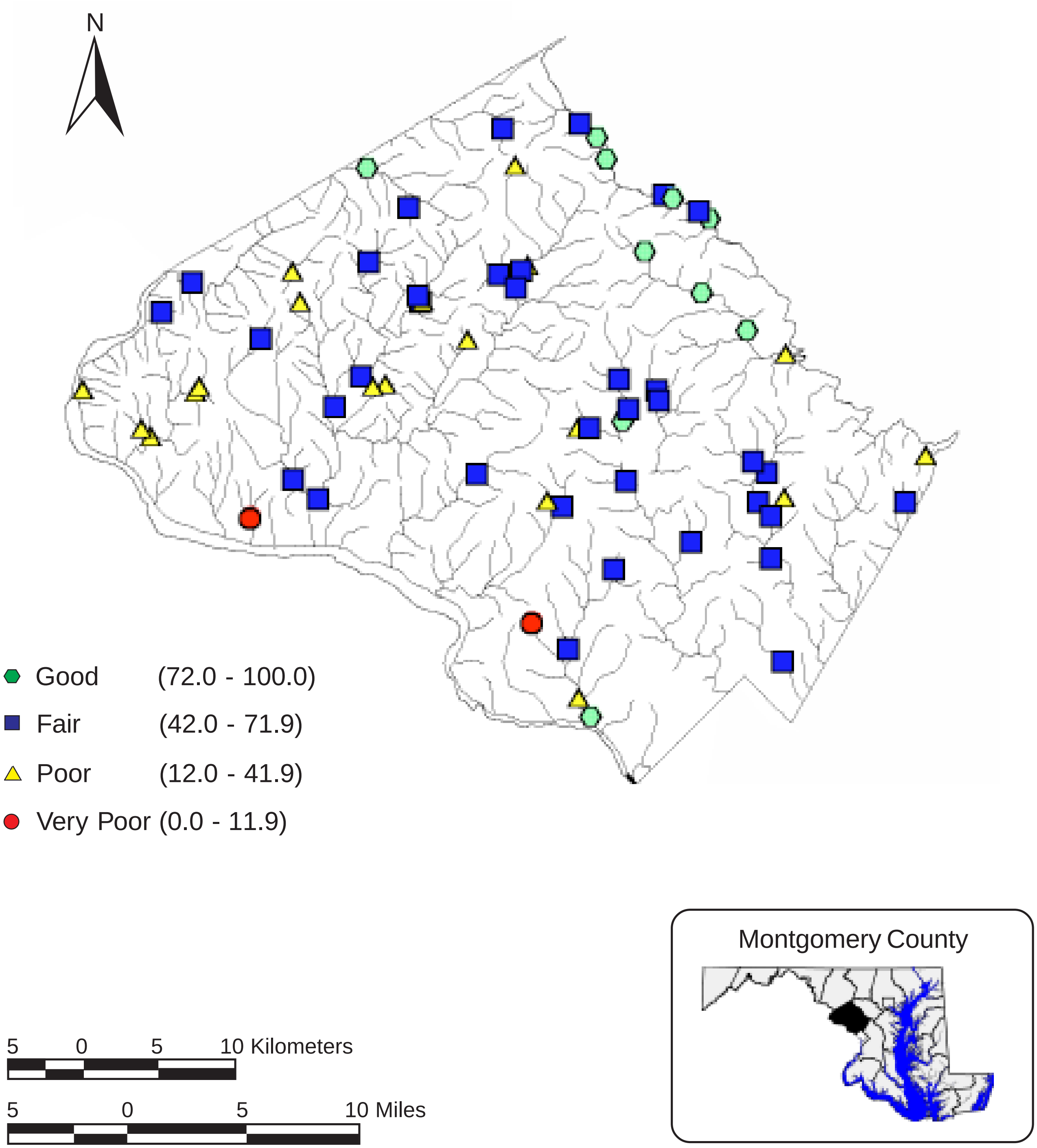

Figure 5. Stream ecological conditions based on the Physical Habitat Index (PHI) at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Table 6. Fish Index of Biotic Integrity (F-IBI), Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI), Family-Level Benthic Macroinvertebrate Index of Biotic Integrity (Fam. IBI), and Physical Habitat Index (PHI) scores at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	Stream Name	F-IBI	B-IBI	Fam. IBI	PHI
HO-P-132-312-97	Mainstem Patuxent R	4.33	3.4		81.28
HO-P-132-319-97	Mainstem Patuxent R	3.67	3.9		51.38
HO-P-194-310-97	Mainstem Patuxent R	4.56	3.7		77.25
HO-P-214-311-97	Mainstem Patuxent R	4.56	4.1		63.33
MO-P-001-214-97	Watts Br	2.14	2.1		55.96
MO-P-006-1-94	Goshen Br	3.86	1.9		
MO-P-006-2-94	Goshen Br	4.33		1.86	
MO-P-014-107-97	Un Trib To Potomac R	2.14	2.8		17.92
MO-P-016-227-97	Broad Run	2.71	2.8		22.18
MO-P-022-3-94	Seneca Cr	1.86	1.7		
MO-P-022-5-94	Seneca Cr			1.29	
MO-P-022-6-94	Seneca Cr				
MO-P-024-307-97	Little Seneca Cr	4.14	4.6		68.83
MO-P-024-315-97	Little Seneca Cr	1.86	3.9		37.81
MO-P-025-1-94	Long Draught Br			1.00	
MO-P-025-2-94	Long Draught Br	1.86	1.9		
MO-P-035-227-97	Hawlings R	3.89	3.4		76.52
MO-P-038-1-94	Watts Br	4.78	1.7		
MO-P-038-2-94	Watts Br			1.00	
MO-P-038-3-94	Watts Br				
MO-P-053-2-94	Goshen Br	3.86	2.3		
MO-P-053-7-94	Goshen Br	3.86		2.43	
MO-P-056-319-97	Northwest Br Anacostia R	3.89	1.7		64.75
MO-P-059-320-97	Mainstem Patuxent R	3.22	4.3		51.38
MO-P-064-328-97	Little Monocacy R	3.57	3.0		49.84
MO-P-069-1-94	Whetstone Run			1.29	
MO-P-069-5-94	Whetstone Run	2.43		1.00	
MO-P-082-124-97	Un Trib To Cabin John Cr	1.67	1.7		60.93
MO-P-086-1-94	Cabin John Cr	2.56		1.29	
MO-P-086-2-94	Cabin John Cr	3.67		1.29	
MO-P-091-204-97	Muddy Br	2.71	2.6		67.95
MO-P-099-1-94	Great Seneca Cr	1.29		1.00	
MO-P-099-2-94	Great Seneca Cr	1.29		1.29	
MO-P-101-126-97	Un Trib To Rock Cr	1.44	1.4		52.40
MO-P-102-308-97	Dry Seneca Cr	4.43	2.6		58.96
MO-P-103-1-94	Watts Br #2	2.71		2.43	
MO-P-103-2-94	Watts Br #2	3.67		3.00	
MO-P-108-123-97	Un Trib To Watts Br	2.71	1.7		41.23
MO-P-110-223-97	Northwest Br	3.67	3.0		47.80
MO-P-111-136-96	Un Trib To Little Bennet Cr		3.2		46.78
MO-P-118-1-94	Goshen Br	3.57	1.4		
MO-P-118-2-94	Goshen Br	3.86	1.2		
MO-P-126-206-97	Hawlings R	3.00	4.8		88.30
MO-P-128-118-97	Bucklodge Br		3.7		13.84
MO-P-129-114-97	Un Trib To Seneca Cr		1.7		18.53
MO-P-129-119-97	Un Trib To Seneca Cr	3.57	3.0		45.25
MO-P-129-131-97	Un Trib To Seneca Cr		2.6		28.75
MO-P-153-113-97	Un Trib To Rock Cr	4.33	2.8		46.27
MO-P-159-110-97	Gunners Br		2.6		13.12

Table 6 (cont.). Fish Index of Biotic Integrity (F-IBI), Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI), Family-Level Benthic Macroinvertebrate Index of Biotic Integrity (Fam. IBI), and Physical Habitat Index (PHI) scores at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	Stream Name	F-IBI	B-IBI	Fam. IBI	PHI
MO-P-180-1-94	Watts Br	3.57	1.2		
MO-P-180-2-94	Watts Br			1.00	
MO-P-180-3-94	Watts Br				
MO-P-182-325-97	Cabin John Cr	3.00	2.6		42.23
MO-P-190-302-97	Dry Seneca Cr	3.57	3.9		54.95
MO-P-192-1-94	Bogley Br	1.00		1.29	
MO-P-192-2-94	Bogley Br			1.00	
MO-P-204-137-97	Un Trib To Rocky Gorge Res	2.33	3.7		36.37
MO-P-206-311-97	Broad Run	3.86	3.4		39.75
MO-P-213-205-97	Hawlings R	4.33	3.7		90.25
MO-P-233-1-94	Watts Br	3.57		1.00	
MO-P-233-2-94	Watts Br	3.57		1.00	
MO-P-245-303-97	Hawlings R	3.00	3.2		35.90
MO-P-248-125-96	Bennet Cr	4.14	3.4		64.75
MO-P-251-115-97	Un Trib To Little Monocacy R	3.00	4.1		16.19
MO-P-252-323-97	Mainstem Patuxent R	4.78	4.3		84.47
MO-P-258-213-97	Little Paint Br	2.78	2.8		71.41
MO-P-265-4-94	Stony Cr	1.00		3.29	
MO-P-265-5-94	Stony Cr		1.7		
MO-P-269-203-97	Sligo Cr	1.44	1.7		62.86
MO-P-276-211-97	Wild Cat Br	4.71	3.4		67.05
MO-P-286-1-94	Whetstone Run	2.14		2.14	
MO-P-286-2-94	Whetstone Run	2.43		1.00	
MO-P-296-1-94	Watts Br			1.29	
MO-P-296-2-94	Watts Br	2.43		1.00	
MO-P-304-127-97	Un Trib To Northwest Br		2.6		32.67
MO-P-308-117-97	Un Trib To Mill Cr	1.22	1.7		29.60
MO-P-310-313-97	Rock Cr	2.78	1.0		65.68
MO-P-311-112-97	Dry Seneca Cr	3.29	4.3		57.96
MO-P-316-205-97	Mill Cr	1.67	2.6		43.23
MO-P-325-208-97	North Br Rock Cr	4.11	3.4		57.96
MO-P-325-216-97	North Br Rock Cr	4.11	3.0		54.44
MO-P-333-207-97	Great Seneca Cr	3.86	3.4		34.04
MO-P-333-224-97	Great Seneca Cr	3.86	3.7		58.96
MO-P-361-8-94	Long Draught Br	3.29		1.29	
MO-P-366-212-97	Ten Mile Cr	4.43	3.9		42.23
MO-P-370-308-97	Mainstem Patuxent R	4.33	3.9		93.54
MO-P-407-225-97	Un Trib To Northwest Br	4.33	3.4		50.35
MO-P-419-1-94	Goshen Br			1.29	
MO-P-419-2-94	Goshen Br	3.29		3.57	
MO-P-428-106-97	Un Trib To Little Seneca Cr	4.71	3.2		66.14
MO-P-432-1-94	Little Falls	1.00		1.29	
MO-P-432-2-94	Little Falls			1.00	
MO-P-436-226-97	Un Trib To Potomac R	1.29	2.6		6.01
MO-P-437-206-97	Rock Cr	4.11	2.8		80.96
MO-P-437-210-97	Rock Cr	3.89	3.7		70.14
MO-P-445-318-97	Great Seneca Cr	4.14	3.7		70.14
MO-P-452-1-94	Long Draught Br			1.00	

Table 6 (cont.). Fish Index of Biotic Integrity (F-IBI), Benthic Macroinvertebrate Index of Biotic Integrity (B-IBI), Family-Level Benthic Macroinvertebrate Index of Biotic Integrity (Fam. IBI), and Physical Habitat Index (PHI) scores at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	Stream Name	F-IBI	B-IBI	Fam. IBI	PHI
MO-P-452-2-94	Long Draught Br		1.8	1.29	
MO-P-454-3-94	Whetstone Run	3.29		1.29	
MO-P-454-4-94	Whetstone Run			1.29	
MO-P-468-109-97	Magruder Br		1.7		40.24
MO-P-470-1-94	Whetstone Run	3.00		2.14	
MO-P-470-2-94	Whetstone Run	3.29	1.4		
MO-P-474-317-97	Seneca Cr	4.43	2.8		63.81
MO-P-478-312-97	Cabin John Cr	2.78	1.7		78.31
MO-P-480-2-94	Cabin John Cr			1.00	
MO-P-480-3-94	Cabin John Cr	3.67		1.00	
MO-P-480-326-97	Cabin John Cr	1.89	1.9		19.16
MO-P-481-101-97	Un Trib To Potomac R		3.2		47.29
MO-P-488-1-94	Cabin John Cr			1.00	
MO-P-488-2-94	Cabin John Cr			1.29	
MO-P-489-314-97	Northwest Br	3.89	1.9		60.44
MO-P-489-323-97	Northwest Br	2.56	1.7		43.73
MO-P-490-2-94	Goshen Br	1.29		1.57	
MO-P-490-3-94	Goshen Br			2.43	
MO-P-490-4-94	Goshen Br				
MO-P-495-312-96	Little Bennet Cr	4.43	3.2		96.48
MO-P-496-215-97	Broad Run	1.86	3.7		27.11
MO-P-500-1-94	Old Farm Cr	2.78		1.29	
MO-P-500-2-94	Old Farm Cr	3.22		1.29	
MO-P-501-1-94	Cabin John Cr	1.89	1.4		
MO-P-501-105-97	Un Trib To Cabin John Cr		1.4		3.15
MO-P-501-3-94	Cabin John Cr	2.11	1.2		
MO-P-508-2-94	Great Seneca Cr	3.57		1.29	
MO-P-508-3-94	Great Seneca Cr	3.86		1.29	
MO-P-514-116-97	Broad Run	3.29	3.9		12.89
PW-M-998-1-94	Little Falls			1.29	
PW-M-998-2-94	Little Falls			1.29	
PW-M-999-3-94	Little Falls			1.00	
PW-M-999-4-94	Little Falls				

Table 7. Water chemistry data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	pH	Conductivity (µS/cm)	Acid Neutralizing Capacity (µeq/L)	Nitrate (mg/L)	Sulfate (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Organic Carbon (mg/L)
HO-P-132-312-97	7.19	0.109	255.80	3.152	4.831	8.50	0.80
HO-P-132-319-97	7.01	0.122	281.60	2.711	6.323	8.70	1.80
HO-P-194-310-97	7.31	0.130	262.50	2.719	6.402	9.10	1.40
HO-P-214-311-97	7.04	0.137	291.40	2.663	7.139	6.30	1.70
MO-P-001-214-97	7.61	0.272	811.40	4.054	13.520	9.30	2.60
MO-P-006-1-94	6.92	0.126	324.26	3.830	7.897		2.00
MO-P-006-2-94							
MO-P-014-107-97	7.32	0.088	496.90	1.310	9.037	5.50	2.80
MO-P-016-227-97	7.15	0.129	515.60	1.760	16.632	8.00	6.10
MO-P-022-3-94	6.96	0.131	359.23	0.787	19.608		3.00
MO-P-022-5-94							
MO-P-024-307-97	7.22	0.163	426.70	3.790	6.156	8.10	2.10
MO-P-024-315-97	7.23	0.165	415.40	3.790	6.161	8.10	1.80
MO-P-025-1-94							
MO-P-025-2-94	7.27	0.548	1177.35	1.874	16.962		4.00
MO-P-035-227-97	7.20	0.114	404.30	1.831	8.447	7.50	2.20
MO-P-038-1-94	7.70	0.264	843.03	2.506	14.571		2.00
MO-P-038-2-94							
MO-P-053-2-94	6.98	0.123	366.50	2.874	8.174		2.00
MO-P-053-7-94							
MO-P-056-319-97	7.75	0.193	845.50	1.530	13.316	9.60	1.90
MO-P-059-320-97	7.12	0.123	289.00	2.823	6.321	8.40	1.50
MO-P-064-328-97	7.28	0.142	608.80	1.825	9.811	8.90	4.00
MO-P-069-1-94	6.86	0.263	587.39	5.090	10.104		4.00
MO-P-069-5-94							
MO-P-082-124-97	7.42	0.335	1339.50	1.986	19.514	9.30	2.90
MO-P-086-1-94							
MO-P-086-2-94	7.52	0.356	909.38	1.726	13.410		3.00
MO-P-091-204-97	7.47	0.383	976.50	2.052	12.768	8.90	2.60
MO-P-099-1-94							
MO-P-099-2-94	6.99	0.370	822.29	2.319	10.510		5.00
MO-P-101-126-97	7.63	0.472	2299.90	1.533	40.040	8.80	2.30
MO-P-102-308-97	7.95	0.186	711.40	2.474	15.707	10.70	2.20
MO-P-103-1-94							
MO-P-103-2-94	7.26	0.194	1124.00	2.752	15.038		1.00
MO-P-108-123-97	7.45	0.417	894.70	5.248	14.191	6.70	3.30
MO-P-110-223-97	7.26	0.149	630.50	1.944	10.359	7.60	3.50
MO-P-111-136-96	6.70	0.767	100.20	0.846	8.272	7.73	1.20
MO-P-118-1-94	6.90	0.127	350.51	3.302	8.209		2.00
MO-P-118-2-94							
MO-P-126-206-97	6.93	0.079	236.00	2.620	4.640	8.30	1.50
MO-P-128-118-97	6.86	0.124	446.50	4.097	10.706	9.30	3.70
MO-P-129-114-97	6.91	0.152	337.30	5.514	6.617	9.10	2.30
MO-P-129-119-97	7.29	0.132	429.40	4.334	7.388	9.40	3.00
MO-P-129-131-97	6.68	0.125	273.80	5.363	6.066	9.20	1.90
MO-P-153-113-97	6.92	0.129	395.00	2.466	7.608	6.80	2.50
MO-P-159-110-97	7.47	0.338	1097.90	0.304	7.547	10.50	1.50
MO-P-180-1-94	7.82	0.287	834.22	2.814	17.043		2.00

Table 7 (cont.). Water chemistry data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	pH	Conductivity (µS/cm)	Acid Neutralizing Capacity (µeq/L)	Nitrate (mg/L)	Sulfate (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Organic Carbon (mg/L)
MO-P-180-2-94							
MO-P-182-325-97	7.65	0.321	1083.40	1.565	16.087	8.20	1.70
MO-P-190-302-97	8.26	0.197	703.30	2.368	14.790	9.20	2.50
MO-P-192-1-94	7.18	0.257	904.77	1.715	15.171		2.00
MO-P-192-2-94							
MO-P-204-137-97	7.27	0.093	336.40	0.912	10.080	8.80	3.00
MO-P-206-311-97	7.48	0.152	624.30	2.451	18.173	7.30	2.60
MO-P-213-205-97	7.27	0.093	291.20	1.985	5.972	7.70	1.80
MO-P-233-1-94	7.56	0.238	751.24	1.797	14.330		4.00
MO-P-233-2-94							
MO-P-245-303-97	7.25	0.143	578.50	1.772	10.420	7.00	2.50
MO-P-248-125-96	7.21	0.218	293.20	2.264	8.807	9.20	0.90
MO-P-251-115-97	6.93	0.092	385.70	1.512	5.614	7.90	3.10
MO-P-252-323-97	7.32	0.129	260.20	3.313	5.954	8.40	1.50
MO-P-258-213-97	7.24	0.167	483.10	1.212	8.771	8.80	2.10
MO-P-265-4-94	6.49	0.121	314.01	2.460	5.471		3.00
MO-P-265-5-94							
MO-P-269-203-97	8.22	0.434	1380.70	2.353	17.353	7.50	2.50
MO-P-276-211-97	7.16	0.118	266.20	4.720	5.005	8.40	0.60
MO-P-286-1-94							
MO-P-286-2-94	7.64	0.299	1155.76	3.456	15.953		2.00
MO-P-296-1-94	7.59	0.367	860.00	4.348	20.794		2.00
MO-P-296-2-94							
MO-P-304-127-97	7.22	0.182	852.10	2.130	11.346	9.90	1.90
MO-P-308-117-97	7.30	0.276	797.40	1.826	10.411	8.60	1.70
MO-P-310-313-97	7.35	0.208	621.90	1.730	8.390	6.80	3.70
MO-P-311-112-97	6.97	0.101	504.10	1.631	9.255	6.80	7.40
MO-P-316-205-97	7.48	0.319	1447.00	1.706	15.771	8.30	2.40
MO-P-325-208-97	7.09	0.098	377.50	1.688	5.795	9.10	3.30
MO-P-325-216-97	7.14	0.103	389.70	1.878	5.965	9.30	3.20
MO-P-333-207-97	7.28	0.153	481.60	3.370	7.594	6.70	1.20
MO-P-333-224-97	7.44	0.156	488.50	3.371	7.508	8.60	1.30
MO-P-361-8-94	7.22	0.478	669.87	0.815	7.330		4.00
MO-P-366-212-97	7.32	0.287	493.40	1.360	9.811	7.80	2.00
MO-P-370-308-97	7.06	0.123	273.90	2.774	6.274	7.60	1.40
MO-P-407-225-97	7.31	0.167	845.40	0.980	13.052	6.80	3.40
MO-P-419-1-94							
MO-P-419-2-94	6.48	0.102	173.06	4.348	5.469		2.00
MO-P-428-106-97	7.02	0.846	405.90	2.158	7.340	8.30	1.70
MO-P-432-1-94							
MO-P-432-2-94	7.49	0.388	1491.22	2.070	23.083		5.00
MO-P-436-226-97	7.25	0.201	1156.10	1.454	25.166	6.40	3.50
MO-P-437-206-97	7.17	0.122	414.00	2.662	7.892	9.70	1.70
MO-P-437-210-97	7.12	0.123	401.90	2.754	7.760	7.90	2.00
MO-P-445-318-97	7.33	0.148	466.20	3.614	6.865	7.70	1.30
MO-P-452-1-94							
MO-P-452-2-94	7.32	0.301	979.14	2.358	21.720		2.00
MO-P-454-3-94	7.61	0.352	1495.97	2.993	10.626		3.00

Table 7 (cont.). Water chemistry data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

Site	pH	Conductivity (µS/cm)	Acid Neutralizing Capacity (µeq/L)	Nitrate (mg/L)	Sulfate (mg/L)	Dissolved Oxygen (mg/L)	Dissolved Organic Carbon (mg/L)
MO-P-454-4-94							
MO-P-468-109-97	7.54	0.642	1357.90	2.617	18.856	6.00	0.80
MO-P-470-1-94							
MO-P-470-2-94	7.12	0.336	874.51	1.989	12.009		3.00
MO-P-474-317-97	7.30	0.159	564.70	1.577	8.373	9.90	3.00
MO-P-478-312-97	8.09	0.357	1347.00	1.730	19.718	9.80	1.90
MO-P-480-2-94							
MO-P-480-3-94	7.58	0.303	998.08	1.955	16.393		3.00
MO-P-480-326-97	7.83	0.331	1200.70	1.788	18.179	9.10	1.90
MO-P-481-101-97	7.20	0.327	1687.20	1.324	39.935	8.00	20.60
MO-P-488-1-94	7.39	0.428	944.05	1.890	12.026		2.00
MO-P-488-2-94							
MO-P-489-314-97	7.32	0.178	827.60	1.572	13.383	8.90	3.80
MO-P-489-323-97	7.31	0.180	810.40	1.564	13.224	8.20	3.80
MO-P-490-2-94	6.93	0.242	512.52	4.577	6.190		2.00
MO-P-490-3-94							
MO-P-495-312-96	7.35	0.140	454.90	2.605	7.177	9.70	1.20
MO-P-496-215-97	6.76	0.083	199.00	2.548	6.776	9.80	1.50
MO-P-500-1-94							
MO-P-500-2-94	7.67	0.267	1037.75	1.678	14.758		4.00
MO-P-501-1-94							
MO-P-501-105-97	7.72	0.033	1884.90	0.632	33.133	7.80	3.20
MO-P-501-3-94	7.27	0.235	1458.14	0.191	35.567		4.00
MO-P-508-2-94	7.44	0.170	936.99	1.738	8.379		2.00
MO-P-508-3-94							
MO-P-514-116-97	7.10	0.124	481.60	1.831	16.616	7.60	6.10
PW-M-998-1-94	7.43	0.535	1387.89	2.161	30.309		4.00
PW-M-998-2-94							
PW-M-999-3-94	7.12	0.128	599.45	0.674	6.302		5.00
PW-M-999-4-94							

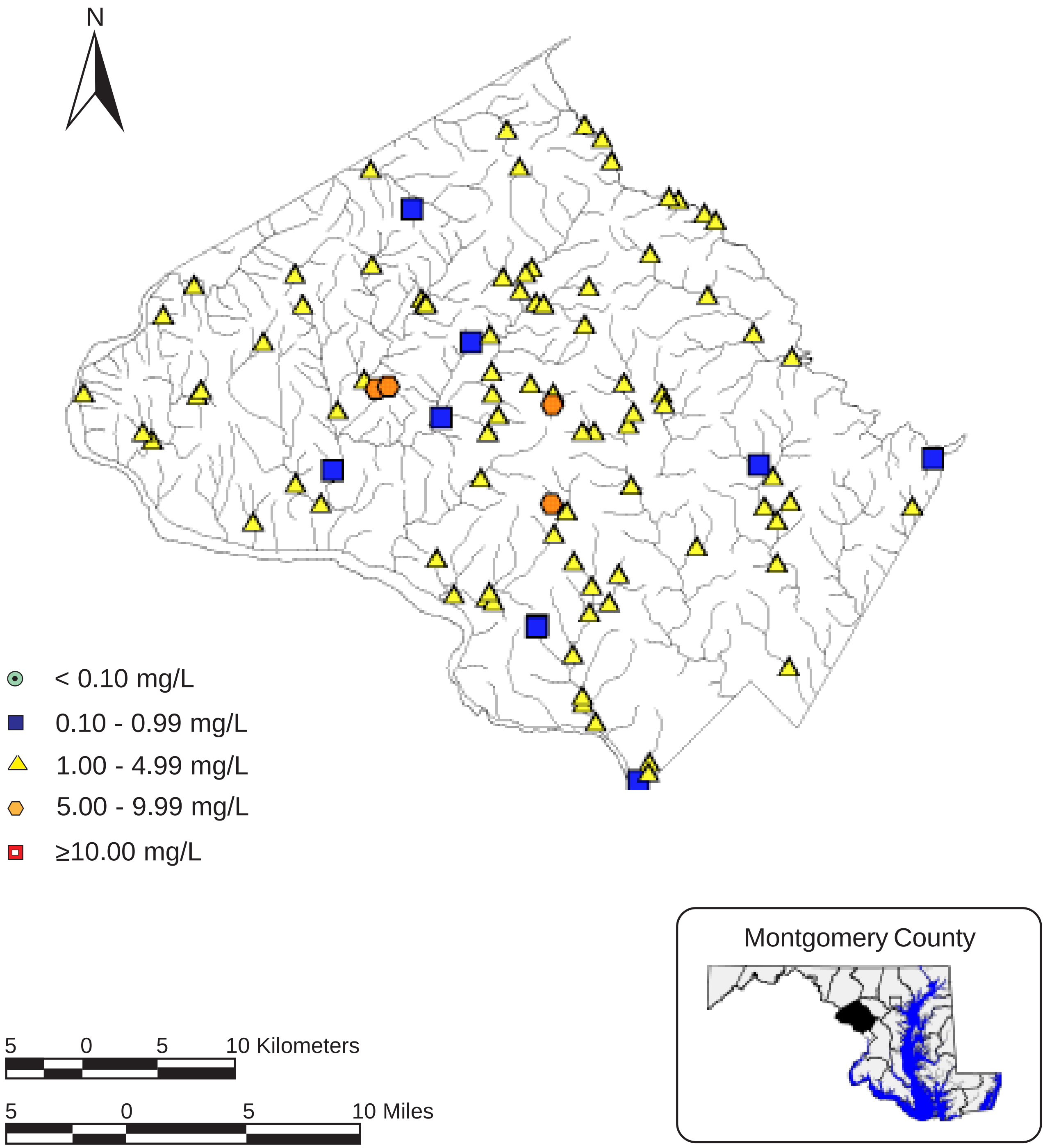

Figure 6. Nitrate-nitrogen concentrations (mg/L) at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997.

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Literature Cited

Barbour, M.T., and J.B. Stribling. 1991. Use of habitat assessment in evaluating the biological integrity of stream communities. In: Biological Criteria: Research and Regulation. U.S. Environmental Protection Agency, Washington, D.C. EPA-440/5-91-005. pp. 25-38.

Cairns, J. and J.R. Pratt. 1993. A history of biological monitoring using benthic macroinvertebrates. In Rosenberg, D.M. and V.H. Resh, eds. Freshwater Monitoring and Benthic Macroinvertebrates. Chapman and Hall, New York

CBRM (Chesapeake Bay Research and Monitoring Division). 1989. Acid deposition in Maryland. Summary of results through 1988. Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. AD-89-1. NTIS No. PB89-182729/AS.

Chaillou, J.C. 1995. Technical Memorandum, The Maryland Biological Stream Survey: Summary of landowner contact procedures. Prepared by Versar, Inc., Columbia, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD. CBWP-MANTA-EA-95-1.

Cochran, W.G. 1977. Sampling Techniques. 3rd ed. New York: John Wiley and Sons.

EPA (U.S. Environmental Protection Agency). 1987. Handbook of methods for acid deposition studies: Laboratory analysis for surface water chemistry. EPA-600/4-87/026.

Hall, L.W., Jr., R.P. Morgan II, E.S. Perry, A. Waltz. 1999. Development of a provisional physical habitat index for Maryland freshwater streams. Prepared by Wye Research and Education Center, Queenstown, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment 455.

Heimbuch, D.G., J.C. Seibel, H.T. Wilson, P.F. Kazyak. 1999. A multiyear lattice sampling design for Maryland-wide fish abundance estimation. Journal of Agricultural, Biological, and Environmental Statistics. 4: 443-455.

Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist 20: 31-39.

Janicki, A., D. Wade, D. Heimbuch, H. Wilson, P. Jacobson, P. Kazyak. 1993. Maryland Biological Stream Survey design report. Prepared for Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division, by Coastal Environmental Services, Linthicum, MD. CBRM-AD-93-1.

Jessen, R.J. 1978. Statistical Survey Techniques. John Wiley, New York.

Karr. J.R. 1991. Biological integrity: A long-neglected aspect of water resource management. Ecological Applications 1: 66-84.

Karr, J.R., K.D. Fausch, P.L. Angermeier, P.R. Yant, and I.J. Schlosser. 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey Special Publication 5. 28 pp.

Kazyak, P.F. 1996. Maryland Biological Stream Survey Sampling Manual. Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division.

Kazyak, P.F. 1994. Maryland Biological Stream Survey Sampling Manual. Prepared by Versar, Inc., Columbia, MD, for Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division.

Kerans, B.L. and J.R. Karr. 1994. A benthic index of biotic integrity (B-IBI) for rivers of the Tennessee valley. Ecological Applications 4: 768-785.

Knapp, C.M., W.P. Saunders, D.G. Heimbuch, H.S. Greening, and G.J. Filbin. 1988. Maryland

Synoptic Stream Chemistry Survey: Estimating the number and distribution of streams affected by or at risk from acidification. Prepared by International Science and Technology, Inc., Reston, VA, for the Maryland Department of Natural Resources, Power Plant Research Program, Annapolis, MD. AD-88-2. NTIS No. PB88-213996/AS.

Knapp, C.M. and W.P. Saunders. 1987. Maryland Synoptic Stream Chemistry Survey design report. Prepared by International Science and Technology, Inc. for Maryland Department of Natural Resources, Power Plant Research Program. AD-87-5.

Lenat, D.R. 1988. Water quality assessment of streams using a qualitative collection method for benthic macroinvertebrates. Journal of North American Benthological Society 7: 222-223.

Miller, D.L., P.M. Leonard, R.M. Hughes, J.R. Karr, P.B. Moyle, L.H. Schrader, B.A. Thompson, R.A. Daniels, K.S. Fausch, G.A. Fitzhugh, J.R. Gammon, D.B. Halliwell, P.L. Angermeier, and D.J. Orth. 1988. Regional applications of an index of biotic integrity for use in water resource management. Fisheries 13(5): 12-20.

Ohio EPA (Ohio Environmental Protection Agency). 1987. Biological criteria for the protection of aquatic life. Volumes I-III. Ohio EPA, Division of Water Quality Monitoring and Assessment, Surface Water Section, Columbus, Ohio.

Plafkin, J.L., M.T. Barbour, K.D. Porter, S.K. Gross and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers: Benthic macroinvertebrates and fish. U.S. Environmental Protection Agency, Office of Water, Washington, D.C. EPA 440-4-89-001.

Ranasinghe, J.A., S.B. Weisberg, D.M. Dauer, L.C. Schaffner, R.J. Diaz, and J.B. Frithsen. 1994. Chesapeake Bay Benthic Community Restoration Goals. Prepared by Versar, Inc. for U.S. EPA and the Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division.

Rankin, E.T. 1989. The Qualitative Habitat Evaluation Index (QHEI): Rationale, methods, and application. Ohio EPA, Division of Water Quality Planning and Assessment, Ecological Analysis Section, Columbus, OH.

Resh, V. H., 1995. Freshwater benthic macroinvertebrates and rapid assessment procedures for water quality monitoring in the developing and newly industrialized countries. In: Davis, W.S. and T.P. Simon, eds. 1995. Biological assessment and criteria: tools for water resource planning and decision making. Lewis Publishers, Boca Raton, FL.

Roth, N.E., M.T. Southerland, G. Mercurio, J.C. Chaillou, P.F. Kazyak, S.A. Stranko, A.P. Prochaska, D.G. Heimbuch, and J.C. Seibel. 1999. State of the Streams: 1995-1997 Maryland Biological Stream Survey Results. Prepared by Versar, Inc., Columbia, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. CBWP-MANTA-EA-99-6.

Roth, N.E., M.T. Southerland, J.C. Chaillou, H.T. Wilson, D.G. Heimbuch, and J.C. Seibel. 1998a. Maryland Biological Stream Survey: Ecological Status of Non-tidal Streams Sampled in 1996. Prepared by Versar, Inc., Columbia, MD, and Post, Buckley, Schuh, and Jernigan, Inc., Bowie, MD, for Maryland Department of Natural Resources, Monitoring and Non-Tidal Assessment Division. CBWP- MANTA-EA-98-1.

Roth, N.E., M.T. Southerland, J.C. Chaillou, R.J. Klauda, P.F. Kazyak, S.A. Stranko, S.B. Weisberg, L.W. Hall, Jr., and R.P. Morgan II. 1998b. Maryland Biological Stream Survey: Development of a Fish Index of Biotic Integrity. Environmental Management and Assessment 51: 89-106.

Roth, N.E., M.T. Southerland, J.C. Chaillou, J.H. Volstad, S.B. Weisberg, H.T. Wilson, D.G. Heimbuch, and J.C. Seibel. 1997. Maryland Biological Stream Survey: Ecological Status of Non-Tidal Streams in Six Basins Sampled in 1995. Prepared by Versar, Inc., Columbia, MD and Coastal Environmental Services, Linthicum, MD for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division. CBWP-MANTA-EA-97-2.

Simon, T.P. ed. 1999. Assessing the Sustainability and Biological Integrity of Water Resources Using Fish Communities. CRC Press, Washington DC.

Strahler, A.N. 1957. Quantitative analysis of watershed geomorphology. Transactions of the American Geophysical Union 38(6): 913-920.

Stribling, J.B., B.K. Jessup, J.S. White, D. Boward, M. Hurd. 1998. Development of a benthic index of biotic integrity for Maryland streams. Prepared by Tetra Tech, Inc., Owings Mills, MD, for Maryland Department of Natural Resources, Monitoring and Non-tidal Assessment Division, Annapolis, MD. CBWP-EA-98-3.

Tornatore, T., P. Jacobson, J. Gerritsen and A. Janicki. 1992. Data sets for developing measures of biological integrity in Maryland streams. Prepared by Versar, Inc., Columbia, MD, for the Maryland Department of Natural Resources, Chesapeake Bay Research and Monitoring Division, Annapolis, MD. AD-93-7.

Weisberg, S.B., J.A. Ranasinghe, D.M. Dauer, L.C. Schaffner, R.J. Diaz , and J.B. Frithsen. 1997. An estuarine benthic index of biotic integrity (B-IBI) for Chesapeake Bay. Estuaries 20:149-158.

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Appendix A. Summary of the types of data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations used are as follows: F-IBI - Fish Index of Biotic Integrity; B-IBI Benthic Macroinvertebrate Index of Biotic Integrity; Fam.IBI - Family-Level Benthic Macroinvertebrate Index of Biotic Integrity; PHI - Physical Habitat Index.

Site	Stream Name	Fish	Benthic Macroinvertebrate	Herpetofauna	Habitat	Water Chemistry	F-IBI	B-IBI	Fam.IBI	PHI
HO-P-132-312-97	Mainstem Patuxent R	X	X	X	X	X	X	X		X
HO-P-132-319-97	Mainstem Patuxent R	X	X	X	X	X	X	X		X
HO-P-194-310-97	Mainstem Patuxent R	X	X	X	X	X	X	X		X
HO-P-214-311-97	Mainstem Patuxent R	X	X	X	X	X	X	X		X
MO-P-001-214-97	Watts Br	X	X	X	X	X	X	X		X
MO-P-006-1-94	Goshen Br	X	X	X	X	X	X	X		
MO-P-006-2-94	Goshen Br	X	X	X	X		X		X	
MO-P-014-107-97	Un Trib To Potomac R	X	X	X	X	X	X	X		X
MO-P-016-227-97	Broad Run	X	X	X	X	X	X	X		X
MO-P-022-3-94	Seneca Cr	X	X	X	X	X	X	X		
MO-P-022-5-94	Seneca Cr		X						X	
MO-P-022-6-94	Seneca Cr	X		X	X					
MO-P-024-307-97	Little Seneca Cr	X	X	X	X	X	X	X		X
MO-P-024-315-97	Little Seneca Cr	X	X	X	X	X	X	X		X
MO-P-025-1-94	Long Draught Br	X	X	X	X				X	
MO-P-025-2-94	Long Draught Br	X	X	X	X	X	X	X		
MO-P-035-227-97	Hawlings R	X	X	X	X	X	X	X		X
MO-P-038-1-94	Watts Br	X	X	X	X	X	X	X		
MO-P-038-2-94	Watts Br		X						X	
MO-P-038-3-94	Watts Br	X		X	X					
MO-P-053-2-94	Goshen Br	X	X	X	X	X	X	X		
MO-P-053-7-94	Goshen Br	X	X	X	X		X		X	
MO-P-056-319-97	Northwest Br Anacostia R	X	X	X	X	X	X	X		X
MO-P-059-320-97	Mainstem Patuxent R	X	X	X	X	X	X	X		X
MO-P-064-328-97	Little Monocacy R	X	X	X	X	X	X	X		X
MO-P-069-1-94	Whetstone Run		X			X			X	
MO-P-069-5-94	Whetstone Run	X	X	X	X		X		X	
MO-P-082-124-97	Un Trib To Cabin John Cr	X	X	X	X	X	X	X		X
MO-P-086-1-94	Cabin John Cr	X	X	X	X		X		X	
MO-P-086-2-94	Cabin John Cr	X	X	X	X	X	X		X	
MO-P-091-204-97	Muddy Br	X	X	X	X	X	X	X		X
MO-P-099-1-94	Great Seneca Cr	X	X	X	X		X		X	
MO-P-099-2-94	Great Seneca Cr	X	X	X	X	X	X		X	
MO-P-101-126-97	Un Trib To Rock Cr	X	X	X	X	X	X	X		X
MO-P-102-308-97	Dry Seneca Cr	X	X	X	X	X	X	X		X

Appendix A (cont.). Summary of the types of data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations used are as follows: F-IBI - Fish Index of Biotic Integrity; B-IBI - Benthic Macroinvertebrate Index of Biotic Integrity; Fam. IBI - Family-Level Benthic Macroinvertebrate Index of Biotic Integrity; PHI - Physical Habitat Index.

Site	Stream Name	Fish	Benthic Macroinvertebrate	Herpetofauna	Habitat	Water Chemistry	F-IBI	B-IBI	Fam. IBI	PHI
MO-P-103-1-94	Watts Br #2	X	X	X	X		X		X	
MO-P-103-2-94	Watts Br #2	X	X	X	X	X	X		X	
MO-P-108-123-97	Un Trib To Watts Br	X	X	X	X	X	X	X		X
MO-P-110-223-97	Northwest Br	X	X	X	X	X	X	X		X
MO-P-111-136-96	Un Trib To Little Bennet Cr	X	X	X	X	X		X		X
MO-P-118-1-94	Goshen Br	X	X	X	X	X	X	X		
MO-P-118-2-94	Goshen Br	X	X	X	X		X	X		
MO-P-126-206-97	Hawlings R	X	X	X	X	X	X	X		X
MO-P-128-118-97	Bucklodge Br	X	X	X	X	X		X		X
MO-P-129-114-97	Un Trib To Seneca Cr	X	X	X	X	X		X		X
MO-P-129-119-97	Un Trib To Seneca Cr	X	X	X	X	X	X	X		X
MO-P-129-131-97	Un Trib To Seneca Cr	X	X	X	X	X		X		X
MO-P-153-113-97	Un Trib To Rock Cr	X	X	X	X	X	X	X		X
MO-P-159-110-97	Gunners Br	X	X	X	X	X		X		X
MO-P-180-1-94	Watts Br	X	X	X	X	X	X	X		
MO-P-180-2-94	Watts Br		X						X	
MO-P-180-3-94	Watts Br	X		X	X					
MO-P-182-325-97	Cabin John Cr	X	X	X	X	X	X	X		X
MO-P-190-302-97	Dry Seneca Cr	X	X	X	X	X	X	X		X
MO-P-192-1-94	Bogley Br	X	X	X	X	X	X		X	
MO-P-192-2-94	Bogley Br	X	X	X	X				X	
MO-P-204-137-97	Un Trib To Rocky Gorge Res	X	X	X	X	X	X	X		X
MO-P-206-311-97	Broad Run	X	X	X	X	X	X	X		X
MO-P-213-205-97	Hawlings R	X	X	X	X	X	X	X		X
MO-P-233-1-94	Watts Br	X	X	X	X	X	X		X	
MO-P-233-2-94	Watts Br	X	X	X	X		X		X	
MO-P-245-303-97	Hawlings R	X	X	X	X	X	X	X		X
MO-P-248-125-96	Bennet Cr	X	X	X	X	X	X	X		X
MO-P-251-115-97	Un Trib To Little Monocacy R	X	X	X	X	X	X	X		X
MO-P-252-323-97	Mainstem Patuxent R	X	X	X	X	X	X	X		X
MO-P-258-213-97	Little Paint Br	X	X	X	X	X	X	X		X
MO-P-265-4-94	Stony Cr	X	X	X	X	X	X		X	
MO-P-265-5-94	Stony Cr	X	X	X	X			X		
MO-P-269-203-97	Sligo Cr	X	X	X	X	X	X	X		X
MO-P-276-211-97	Wild Cat Br	X	X	X	X	X	X	X		X

Appendix A (cont.). Summary of the types of data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations used are as follows: F-IBI - Fish Index of Biotic Integrity; B-IBI - Benthic Macroinvertebrate Index of Biotic Integrity; Fam. IBI - Family-Level Benthic Macroinvertebrate Index of Biotic Integrity; PHI - Physical Habitat Index.

Site	Stream Name	Fish	Benthic Macroinvertebrate	Herpetofauna	Habitat	Water Chemistry	F-IBI	B-IBI	Fam. IBI	PHI
MO-P-286-1-94	Whetstone Run	X	X	X	X		X		X	
MO-P-286-2-94	Whetstone Run	X	X	X	X	X	X		X	
MO-P-296-1-94	Watts Br	X	X	X	X	X			X	
MO-P-296-2-94	Watts Br	X	X	X	X		X		X	
MO-P-304-127-97	Un Trib To Northwest Br	X	X	X	X	X		X		X
MO-P-308-117-97	Un Trib To Mill Cr	X	X	X	X	X	X	X		X
MO-P-310-313-97	Rock Cr	X	X	X	X	X	X	X		X
MO-P-311-112-97	Dry Seneca Cr	X	X	X	X	X	X	X		X
MO-P-316-205-97	Mill Cr	X	X	X	X	X	X	X		X
MO-P-325-208-97	North Br Rock Cr	X	X	X	X	X	X	X		X
MO-P-325-216-97	North Br Rock Cr	X	X	X	X	X	X	X		X
MO-P-333-207-97	Great Seneca Cr	X	X	X	X	X	X	X		X
MO-P-333-224-97	Great Seneca Cr	X	X	X	X	X	X	X		X
MO-P-361-8-94	Long Draught Br	X	X	X	X	X	X		X	
MO-P-366-212-97	Ten Mile Cr	X	X	X	X	X	X	X		X
MO-P-370-308-97	Mainstem Patuxent R	X	X	X	X	X	X	X		X
MO-P-407-225-97	Un Trib To Northwest Br	X	X	X	X	X	X	X		X
MO-P-419-1-94	Goshen Br		X						X	
MO-P-419-2-94	Goshen Br	X	X	X	X	X	X		X	
MO-P-428-106-97	Un Trib To Little Seneca Cr	X	X	X	X	X	X	X		X
MO-P-432-1-94	Little Falls	X	X	X	X		X		X	
MO-P-432-2-94	Little Falls	X	X	X	X	X			X	
MO-P-436-226-97	Un Trib To Potomac R	X	X	X	X	X	X	X		X
MO-P-437-206-97	Rock Cr	X	X	X	X	X	X	X		X
MO-P-437-210-97	Rock Cr	X	X	X	X	X	X	X		X
MO-P-445-318-97	Great Seneca Cr	X	X	X	X	X	X	X		X
MO-P-452-1-94	Long Draught Br	X	X	X	X				X	
MO-P-452-2-94	Long Draught Br	X	X	X	X	X			X	
MO-P-454-3-94	Whetstone Run	X	X	X	X	X	X		X	
MO-P-454-4-94	Whetstone Run		X						X	
MO-P-468-109-97	Magruder Br	X	X	X	X	X		X		X
MO-P-470-1-94	Whetstone Run	X	X	X	X		X		X	
MO-P-470-2-94	Whetstone Run	X	X	X	X	X	X	X		
MO-P-474-317-97	Seneca Cr	X	X	X	X	X	X	X		X
MO-P-478-312-97	Cabin John Cr	X	X	X	X	X	X	X		X

Appendix A (cont.). Summary of the types of data collected at Maryland Biological Stream Survey sites in Montgomery County, 1994-1997. Abbreviations used are as follows: F-IBI - Fish Index of Biotic Integrity; B-IBI - Benthic Macroinvertebrate Index of Biotic Integrity; Fam. IBI - Family-Level Benthic Macroinvertebrate Index of Biotic Integrity; PHI - Physical Habitat Index.

Site	Stream Name	Fish	Benthic Macroinvertebrate	Herpetofauna	Habitat	Water Chemistry	F-IBI	B-IBI	Fam. IBI	PHI
MO-P-480-2-94	Cabin John Cr	X	X	X	X				X	
MO-P-480-3-94	Cabin John Cr	X	X	X	X	X	X		X	
MO-P-480-326-97	Cabin John Cr	X	X	X	X	X	X	X		X
MO-P-481-101-97	Un Trib To Potomac R	X	X	X	X	X		X		X
MO-P-488-1-94	Cabin John Cr	X	X	X	X	X			X	
MO-P-488-2-94	Cabin John Cr	X	X	X	X				X	
MO-P-489-314-97	Northwest Br	X	X	X	X	X	X	X		X
MO-P-489-323-97	Northwest Br	X	X	X	X	X	X	X		X
MO-P-490-2-94	Goshen Br	X	X	X	X	X	X		X	
MO-P-490-3-94	Goshen Br		X						X	
MO-P-490-4-94	Goshen Br	X		X	X					
MO-P-495-312-96	Little Bennet Cr	X	X	X	X	X	X	X		X
MO-P-496-215-97	Broad Run	X	X	X	X	X	X	X		X
MO-P-500-1-94	Old Farm Cr	X	X	X	X		X		X	
MO-P-500-2-94	Old Farm Cr	X	X	X	X	X	X		X	
MO-P-501-1-94	Cabin John Cr	X	X	X	X		X	X		
MO-P-501-105-97	Un Trib To Cabin John Cr	X	X	X	X	X		X		X
MO-P-501-3-94	Cabin John Cr	X	X	X	X	X	X	X		
MO-P-508-2-94	Great Seneca Cr	X	X	X	X	X	X		X	
MO-P-508-3-94	Great Seneca Cr	X	X	X	X		X		X	
MO-P-514-116-97	Broad Run	X	X	X	X	X	X	X		X
PW-M-998-1-94	Little Falls	X	X	X	X	X			X	
PW-M-998-2-94	Little Falls	X	X	X	X				X	
PW-M-999-3-94	Little Falls	X	X	X	X	X			X	
PW-M-999-4-94	Little Falls	X		X	X					

Appendix B. Physical habitat condition measured by the Maryland Biological Stream Survey, 1994-1997. All variables rated on a scale of 0 (poor) to 20 (optimal) unless otherwise noted.

SUBSTRATE AND INSTREAM COVER

Instream Habitat is rated according to the perceived value of habitat to the fish community. Higher scores are assigned to sites with a variety of habitat types and particle sizes. In addition, higher scores are assigned to sites with a high degree of uneven substrate, including logs and rootwads. In streams where substrate types are favorable but flows are so low that fish are essentially precluded from using the habitat, low scores are assigned. If none of the habitat within a segment is useable by fish, a score of zero is assigned.

Epifaunal Substrate is rated based on the amount and variety of hard, stable substrates usable by benthic macroinvertebrates. Because they inhibit colonization, flocculent materials or fine sediments surrounding otherwise good substrates are assigned low scores. Scores are also reduced when substrates are less stable.

Velocity/Depth Diversity is rated based on the variety of velocity/depth regimes present at a site (slow-shallow, slow-deep, fast-shallow, and fast-deep). As with embeddedness, this metric varies by stream gradient.

Pool/Glide/Eddy Quality is rated based on the variety and spatial complexity of slow or still water habitat within the sample segment. In high-gradient streams, functionally important slow water habitat may exist in the form of larger eddies. Within a category, higher scores are assigned to segments which have undercut banks, woody debris or other types of cover for fish.

Riffle/Run Quality is based on the depth, complexity, and functional importance of riffle/run habitat in the segment, with highest scores assigned to segments dominated by deeper riffle/run areas, stable substrates, and a variety of current velocities.

Embeddedness is a percentage of surface area of larger particles that is surrounded by fine sediments on the stream bottom. In low gradient streams, embeddedness may be high even in relatively unimpaired watersheds.

CHANNEL CHARACTER

Channel Alteration is a measure of large-scale changes in the shape of the stream channel. Channel alteration includes: concrete channels, artificial embankments, obvious straightening of the natural channel, rip-rap, or other structures, as well as recent bar development. Ratings for this metric are based on the presence of artificial structures as well as the existence, extent, and coarseness of point bars, side bars, and mid-channel bars which indicate the degree of flow fluctuations and substrate stability. Evidence of channelization may sometimes be seen in the form of berms that parallel the stream channel.

Bank Stability is rated based on the presence/absence of riparian vegetation and other stabilizing bank materials such as boulders and rootwads, and frequency/size of erosional areas. Sites with steep slopes are not penalized if banks are composed solely of stable materials.

Channel Flow Status is the percentage of the stream channel that has water, with subtractions made for exposed substrates and dewatered areas.

RIPARIAN CORRIDOR

Shading is rated based on estimates of the degree and duration of shading at a site during summer, including any effects of shading caused by land forms.

Appendix B (cont.). Physical habitat condition measured by the Maryland Biological Stream Survey, 1994-1997. All variables rated on a scale of 0 (poor) to 20 (optimal) unless otherwise noted.

Riparian Buffer is rated according to the size and type of the vegetated riparian buffer zone at the site. Cultivated fields for agriculture that have bare soil to any extent are not considered as riparian buffers. At sites where the buffer width is variable, or direct delivery of storm runoff or sediment to the stream is evident or highly likely, the narrowest representative buffer width in the segment (e.g., 0 if parking lot runoff enters directly to the stream) is measured and recorded even though some of the stream segment may have a well developed riparian buffer.

AESTHETICS/REMOTENESS

Aesthetics are rated according to the visual appeal of the site and presence/absence of human refuse, with highest scores assigned to stream segments with no human refuse and visually outstanding character.

Remoteness is rated based on the absence of detectable human activity and difficulty in accessing the segment.